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WHAT IS PRACTICAL IN AGRICULTURE

About fifty years ago, in the United States, when really active development of agricultural science was beginning, the hard-headed farmers of the country, generally, looked upon the movement with doubt and suspicion. They dubbed it "book farming" and denounced it as "impractical bosh." However, their skepticism did not hold up progress. American farming has been revolutionized by scientific investigation and today none are more appreciative of this outcome than the American farmers themselves.

In the Philippines, in matters of general agricultural development we stand about where Americans stood, forty years ago. Here also, we hear the same old line of talk as to distinguishing between "science" and "practice". This talk, of course, comes largely from men who do not know of what Science consists. As a matter of fact *Science* is nothing more than *organized and co-ordinated truth.*

Since the days of Liebig, as men have applied the methods of science to agriculture they have been discovering a whole marvellous world of reason and fact beneath the common operations of agriculture. Formerly farmers lived in the densest ignorance as to the whys and wherefores of some of their simplest operations. Practice had slowly evolved through painful empiricism, with still a vast proportion of failures in the common results, after centuries of trying. In other words, the farmer was like the chauffeur who can steer the car, and even repair a tire, but who has no knowledge of the mechanism under the hood. When something goes wrong there, the car becomes useless, the chauffeur must seek a new car because of inability to understand or correct the defects of the old one. The enormous wastefulness because of ignorance in agriculture is now generally

recognized. Today we are demanding chauffeurs with real knowledge of gas engines and farmers who know enough of chemistry, agronomy, plant breeding, plant pathology, entomology, and the principles of animal husbandry to successfully crop the soil, and to secure the maximum returns for labor expended. Can it be doubted for a moment that the most efficient engineer will be the one best grounded in mathematics, physics, and the other sciences fundamental to engineering? Can it be doubted that other things being equal, the greatest surgeon will be the one who has had the best fundamental training in anatomy, physiology, bacteriology, chemistry, and other basic sciences?

It therefore follows that the *most practical* man is the one who understands most fully and completely the reasons for all that he does. It also follows that science is nothing if not *practical*, and that there cannot be practice of a high grade of efficiency and success without its being scientific. A few years ago a young man was heard to ask a very prominent American educator this question: "I wish to study *practice*, without wasting time on fundamental science. At what American institution can I do this?" The eminent educator's eyes opened with unfeigned surprise, and his reply was "At not one, Sir, not one!"

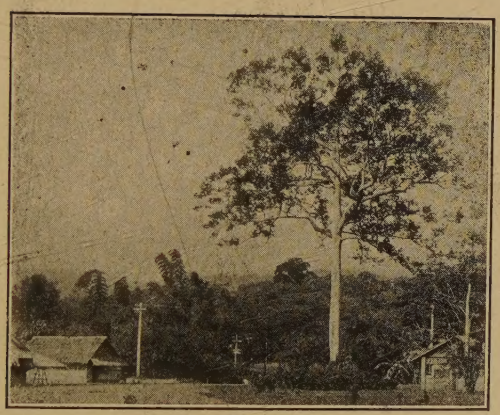
Among modern expressions of activity in scientific agriculture, the "experiment station" is subject to much doubt and criticism from the ignorant as something useless and impractical. The object of the experiment stations, now widely and fully developed in all progressive countries, is comprehensive trial of all possible methods and materials under all possible conditions, not only to determine, beyond any possibility of mistake, the most practical methods and materials under all conditions, but to obtain thorough and complete understanding of all factors and conditions involved. Nothing could be more *practical.* Naturally, many of the trials and tests will be negative or outright failures, and it is infinitely desirable that these failures *should be secured* at government expense, and in charge of trained men, in order that the *reasons for failure* may be carefully studied and fully understood, thus and only thus making it possible to warn farmers against similar errors. On the other hand, the experiment station secures a large proportion of successes, and develops to a large degree improved methods and these are given to the farmers throughout the land. It is now universally recognized that there cannot be sound agricultural education and extension without the effective development of experiment station work—and this is doubly true in a new country.

A student of the College of Agriculture was once breeding a lot of minute flies in glass jars in the laboratory, studying their life activities, their habits and the parasites that preyed on them. A casual and uninformed visitor concluded from seeing this, that the work of the College of Agriculture was highly impractical and useless. Through ignorance he erred in judgment for the insect involved in this case is one of the worst pests of beans in the world and wipes out whole fields of mungo and other beans at certain seasons, in the Philippines. The work of this student, Otanes, established the fact that the entire active life of the insect was confined to about three months of the year and that injury from it could be largely avoided by the simple device of planting in other months. Moreover, he discovered that certain varieties of beans were entirely immune to attack and that therefore these particular beans could be planted in the worst maggot

season. He thus established a sound agronomical method for the safe cropping of beans in this region. Could anything, by any possibility, be more *practical* than work of this sort?

That man is most practical who can not only use tools and follow stereotyped methods, but who knows thoroughly well the fundamental reasons underlying the use or the method and who does not disdain knowledge from books or any other source that will contribute to his more complete understanding.

CHARLES F. BAKER,
Dean, College of Agriculture.



A Campus Landmark.

PRACTICAL WORK ON THE COLLEGE OF AGRICULTURE FARM

By Inocencio Elayda
Of the Department of Agronomy

SIX PLATES

The policy that has ever been followed by the Agronomy Department of the College of Agriculture, as regards practical work, can be seen in the results obtained and in what is being done on the College Farm. The primary function of the Agronomy Department in practical work must of necessity be highly diversified in nature, to meet the needs of instruction. It was fully realized from the very beginning that the teaching relating to Philippine crops, or agronomy and horticulture, can be effectively done only by having first hand knowledge of both the theoretical and practical sides. This can be obtained only by making trials and tests intended to elucidate an endless number of points heretofore unknown or not definitely established, relative to Philippine farming. As our agriculture is new and undeveloped, it must be admitted that well systematized experimentation should be carried on to embrace the different regions of the Islands before any teaching and extension work may be safe. In our Agronomy Department, teaching has been constantly co-ordinated with experimental work; but the latter has been restricted to local conditions, since there was no provision for a comprehensive plan of experimentation for these Islands. Therefore a beginning was made on the College Farm with the view of ultimately extending the work as fast as provision and facilities became available. For it stands to reason that "Philippine Agriculture" must take into account all of the different conditions of the country; else it is a misnomer.

COLLEGE FARM

EARLY WORK

As in many Colleges of Agriculture, if not all, this College began with the establishment of a farm. The field or practical work involved was started at the same time as the teaching work, if the latter was not antedated by the former. This early work constitutes one of the most important parts of the history of the College. The original College area was practically wild country, the land being, with a scant exception, covered with cogon, brush, and second-growth forest. There were small fields under cultivation, but they were surrounded by hedge rows of weeds and small and big trees as boundary lines separating fields from one another and occupying a considerable area with waste. There were also fields, once clean, that had gone back to weeds and which necessitated practically a new and expensive clearing to bring them again into a state of cultivation.

In view of the above condition, the first task that stared the Agronomy Department in the face was to clear the land before it would lend itself to tillage and cultural operations. Underbrushing of the forest growth and digging and grubbing of stumps and standing trees were necessary. Areas with solid growth of weeds, shrubs, and trees were in that way gone over painfully, little by little.

Wild hedge rows were removed to enlarge the extent of the fields for more convenient handling. In some of the fields, boulders varying in size were found here and there, some being under the ground above the ordinary plow line, necessitating removal from the field or burial deeper to clear the way for the plows and cultivators. This involved the use of light and heavy tools such as bolos, picks, mattocks, crowbars, hand lever stump pullers, besides animals to pull out the rubbish and unearthed stumps. Then the land was broken with heavy plows hitched to teams of two or three animals yoked abreast, (for which the beasts were previously trained, since they are used only for working alone with the native light plow). These operations were carried along day after day in the sun or in the rain, so as to get the crops into the ground in the quickest possible time.

It is interesting to note that it was mostly the pioneer students of this College who did this work with the manual aid and under the direction of the professors and instructors of both the Departments of Agronomy and Animal Husbandry. Little help was rendered by day laborers, for the reason that these were employed to take care of the farm animals and do other kinds of work.

In addition to the above tasks, the energy of the pioneer students was considerably taxed in providing for their own personal accommodation. As there were no housing facilities on the campus in those early days of the College, the students built their own dwellings of frail materials (bamboo and nipas). They used for this purpose part of the holidays and what little spare time they could find on ordinary working days, aside from their class room studies and their required field work. They had to procure the materials and the help needed to construct those dwellings, and paid for all the expenses out of their own pockets. It was with great difficulty, as in any pioneer work, that they carried out this work; judging from the strenuous living conditions found on the College ground at a later date. To this is to be added the work of surveying the farm and making the athletic field which involved surveying, clearing, grading, and the work of maintenance.

As a result of this pioneer work, the following accomplishment was in evidence by the latter part of the year 1911 (two years after the establishment of the College); a set of a few beds for gardening, culture trials, and acclimatization work; several fields devoted to staple and secondary crops; a small nursery by the Molawin River, which traverses the farm, for both garden work and in preparation for orchard plantings; a small irrigation ditch headed by an earth dam which diverted part of the water in the Molawin River to irrigate the nursery; a plot of various species of rubber on land prepared in the fashion of the native *caiñgin* (the primitive method of preparing virgin land for crude planting); a small sample orchard of various kinds of native and introduced fruit trees; small irregular fields ready for cultivation; an athletic field, and a group of nipa and bamboo houses known as the Students' Barrio where the students lived.

LATER WORK

Naturally, the field covered by the activities of the Agronomy Department was maintained and rapidly extended inasmuch as it is the most important department in a College of Agriculture. By the year 1912, much still remained on the original area of the College Farm to be cleared before it could be brought to tillage. The present lawns around the buildings were in cogon areas with wild trees and undergrowth here and there. A fairly extensive thick bamboo

grove was a striking sight where now are the larger-sized rice paddies. The fields below the grove, extending a little beyond the provincial road on the right side as the College ground is entered to the limit of the College land, were still obstructed by overgrown hedge rows. And the rest of the land, much greater in extent than the first cleared portion of the land on both sides of the river, was still to be cleared. There was in addition a need of underbrushing and cleaning, especially above and on the banks of the Molawin River, for the protection of the stream and maintenance of native plant species of horticultural interest on the College Campus. Roads, drives, trails, and paths were all to be established. It was borne in mind that all this work, once done, would at the same time improve, as it did, the sanitary conditions of the place.

For its rapid execution as consistent with the needs of instruction, the available force was indeed very limited. A small force of student laborers worked for wages at the rate of ten centavos per hour in their vacant periods during the day. A large force of students were required to do farm work in connection with subjects they were taking under the Agronomy Department. There were only about eight common laborers reporting quite irregularly, to work for both the Agronomy and Animal Husbandry Departments; but at the latter part of the same year (1912), as an emergency measure, the common labor force was increased to a greater number. These combined forces enabled the department to practically finish by the following year the clearing and the bringing under cultivation of most of the area on the east side of the river.

Making of Rice Paddies.—With the completion of the gravity irrigation pipe line built by the Bureau of Public Works for the College of Agriculture, the building of rice paddies was in order. Only a comparatively small amount of surplus water could be used for this purpose, as this water was mainly intended to supply the domestic use of the College community and the need for water in the laboratories. A portion of our present rice paddies was built on a hilly piece of land with a comparatively gentle slope, while the other portion was installed on fairly level ground. The students were thereby given a practical illustration of two main features in the building of rice paddies very likely to be encountered in common practice; namely, rice paddy making on rolling land and on flat ground. In the first case, it was necessary to establish the contour lines at first. The leveling was done by using the water level as a guide, and the dikes were made according to the contour lines. On the flat ground, was shown the importance of running the dikes in straight lines for the sake of more economical handling of the paddies in the preparation of the soil and in planting the crop. It was also shown that the size of the paddies is determined by the inclination of the land and the amount of water available for irrigation; the larger the volume of water and the gentler the grade, the larger the size, and *vice versa*. Students were used side by side with the common laborers in making the paddies.

Making a New Athletic Field.—Following the rearrangement of the fields on the Farm, it was found necessary to turn the old athletic field into acclimatization plots, and a new athletic ground was built on its present location. The initial work on the race track was exclusively done by the agricultural engineering students with common labor, while the baseball diamond and its outskirts were graded and put into their present shape by joint student and common labor. To bring the entire field into a usable form and to maintain it, the whole student body was several times called upon to render whole day's work; and this help is

often resorted to whenever the force of the Agronomy Department in the way of labor is insufficient to meet the hand labor required for certain projects. Thus, the students have the opportunity of not only doing manual work in strictly agricultural projects, but also in those of other or general nature which they are likely to run across when they go out into the world for themselves.

ENLARGEMENT OF THE AREA

FIRST ADDITION

The College Farm has been in effect the Experiment Station for the College of Agriculture. As the work started developed and new projects were added with the increasing number of students, more room was needed to meet the new demands. In this connection relief was had by an addition of something like fourteen hectares of land to the original area of the College Farm. This land was bought by the College for the Animal Husbandry Department to plant corn; and it was finally turned over to the Department of Agronomy for general culture purposes. The land underwent the usual processes of clearing and tillage operations before it was brought to its present state of cultivation. While the students did not take a very active part in the initial preparation of this particular piece of ground, they were benefited by the experience of being in contact with the work and by receiving instruction from the men who were handling the work.

SECOND ADDITION

The Official Experiment Station.—The need for an officially recognized Experiment Station was keenly felt from the establishment of the College of Agriculture. Only quite recently was it finally authorized by an act of the Philippine Legislature. But the enactment of this law does not by any means mark the beginning of experimental work in the College of Agriculture nor in the Agronomy Department. This work has proceeded continuously since this institution commenced the work for which it was created. The results secured by the Department of Agronomy and the other departments of the College bearing on various problems of Philippine Agriculture, have already been published; most of them in the *Philippine Agriculturist*, some in the *Journal of Science* of the Bureau of Science; and some in the *Agricultural Review* of the Bureau of Agriculture. Reference to, and abstracts of, many of these publications appear in foreign scientific papers and in the *Experiment Station Record* of the Department of Agriculture in Washington.

The creation of the Experiment Station for the College was absolutely essential and necessary for the proper realization of its own purposes and for the official recognition of the College experimental work in its relation to the other arms of the Government and to other Experiment Stations here and in other countries. On the other hand, without the additional facilities afforded by the new station, it would be impossible to carry on a considerable part of the work so far accomplished on the College Farm because of its increased needs for land and other facilities. In other words, the Experiment Station has taken over all the work of the College Farm, not to say anything of other work equally important, conducted by the other Departments of the College. The fact that only recently the College has entered into the possession of the land expropriated for the Experiment Station, does not mean in any way that this institution has not done anything in the way

of experimentation to justify the creation of the Experiment Station, for the College of Agriculture. So far as the agronomy side is concerned, experimental work has been going on without being interrupted by the delay thru the expropriation proceedings. Needless to say that agronomy is not all the work involved in the Experiment Station; other departments keep on conducting for the Experiment Station experimental work in other directions in the laboratories and in the fields, which does not necessarily involve the use of an extensive area of land. It is, however, true that some work needing larger areas of land, such as the commercialization of some of the projects of selection work and large field-scale plantings of crops, have been seriously handicapped by the delay in getting possession of the new land for the Experiment Station.

With these new facilities, the students of later years are given better opportunities to acquire the experience to be gained from practical work on the farm although the new Experiment Station land has practically the same conditions, as existed in the old area of the College Farm. While the same operations as before are to be repeated to put the new land in a state of tilth, their advantage lies in the improvement in methods of operation and maturer experience of the instructors with regard to local conditions.

PLANT CULTURES

STAPLE FARM CROPS

Rice and corn, coconut, sugar cane, abaca, and tobacco have held prominent positions in the work of the College Farm. A great number of papers on various topics relating to these staples have been published by the College. These papers represent actual field operations and investigation by the College advanced students touching on various problems in the agronomy of these crops, such as cultural methods, selection and breeding, application of natural and artificial fertilizers, study of varieties, physical characters, curing and handling of products, study and control of certain pests and diseases affecting the crop, farm management of the crops, and other important topics which have to do with increasing the yield and producing more desirable qualities in the product.

SECONDARY FARM CROPS

These crops have been given due attention; in fact many of them received the same careful treatment as the staple crops. The most important of them are mentioned in groups, as follows:

In the grain crops are included sorghum in its different species and varieties and other forms of the grain family; oil plants such as peanuts, sesamum or liñga, castor oil beans, etc.; tuber crops such as sweet potatoes, cassava or camoteng cahoy, arrowroot, yautia or malanga, ubi, and tugui; fiber plants like maguey, jutes, henequen, roselle, china grass and many other introduced and native forms, including the bast fiber plants; and finally, the leguminous plants such as lima beans, soya, the native patani, batao, calamismis, pigeon peas, and many other forms, native as well as introduced kinds.

In treatment these secondary farm crops were cultured not only as crops by themselves, but also in their relation to the staple crops listed above with regard to rotation and the maintenance of soil fertility. The legumes were cultured

on a commercial scale for their marketable products and for their value as cover crops, nurse crops, intercrops, and weed eradicators, in all of which the ability of the plant to gather nitrogen from the air and fix it in the soil was emphasized.

INTRODUCTION AND ACCLIMATIZATION OF EXOTIC PLANTS

This feature of the work of the Agronomy Department has proceeded continuously. Propagation materials have been received and tried on the Farm from different parts of the Islands and from foreign countries of tropical, sub-tropical, and temperate climates, through exchange, presentation, and purchase. For this purpose more than two hundred trial and acclimatization plots are maintained, for which first and second year students with the help of two day laborers are used. Besides these, for the maintenance of the general nursery, horticultural nursery, coffee and cacao nursery, and citrus nursery, the student force is for the most part employed. As a result of the introduction of foreign plants, distinct success has been secured especially with soya beans, avocados, and yautia or malanga, the growing of each promising to be an industry by itself under Philippine conditions; and this is saying nothing of the equal success attained with many valuable introduced varieties of Philippine staple and secondary crops.

PLANT NURSERIES, VEGETABLE GARDENS, AND ORNAMENTALS

Nursery methods are also a subject of careful attention. In many particulars, nursery treatment is applied to garden vegetables as well as to fruit trees and ornamentals. This is especially true in the matter of starting seeds in flats and seed beds, in pricking or transferring seedlings from one receptacle or bed to another, and in transplanting them into their permanent location, as in garden beds, or in their provisional place, as in nursery rows. Various forms of propagation by seed and by division, in their multiple features, are regularly practiced. Seeds are treated according to the nature of the seed coats, to promote quick germination. The propagation of plants by division, such as by the use of parts intact and detached parts is continuously practiced. This involves layering, cutting, budding and grafting, and the use of specialized buds, such as bulbs, stolons, bulblets, and tubers. In this connection, practical work is effected in the preparation of soil for nursery use and in potting plants developed both from seeds or from cuttings and from other kinds of propagating materials mentioned above. For which purpose, earthen pots, bamboo tubes, empty cans, empty cement barrels, and pieces of board fitted together into square or oblong boxes, are used.

PLANTING TREES IN ORCHARDS

The initial work in orcharding takes place, of course, in the nurseries. Before the plants have developed to a proper size for transplanting, the ground is prepared, the orchard laid out, staked, and properly holed and fertilized. When the seedlings are grown in pots, they are hardened and transported in pots from the nursery to the orchard side, without any further preparation previous to setting them into the holes. If grown in nursery rows, they are carefully dug up by either balling them with a portion of earth left intact around the root system, the size of the ball depending upon the size of the plant and the extent in which the roots have spread, or by freeing the larger portion of the roots of the earth adhering to them, avoiding injury as much as possible. When the plants are

started in pots, they are hardened first and then freed from them with the root system undisturbed, so that the plants when transplanted are not set back in their growth, since the stems do not need to be cut back to balance the interdependent activity of the crown and the roots. The opposite is true, however, when the plants are dug up from nursery rows, here the growth is retarded by the trimming of the roots and the stems.

Thus far, the Agronomy Department has established the following orchards:

1. A sample mixed orchard of mangoes, avocados, nankas, guayabano, pili, alpay, ibuli, and various miscellaneous native and foreign fruit trees.

2. A sample orchard of small shrubs of various kinds, with a few representatives of each kind, aggregating about six hectares.

3. Three orange groves of different varieties, including the work of searching for canker-resistant varieties of citrus conducted by the United States Department of Agriculture, occupying about five hectares.

4. Two coffee plantations of arabica, robusta, and liberica types, one of which, six and one-half hectares in extent, is on a high pleateau on the base of Mount Makiling, and the other, one hectare in extent, is further up the slope of the same mountain.

5. A five-hectare cacao plantation, adjoining the lower coffee plantation.

6. Adjoining the smaller coffee plantation, an orchard of two hectares in mangosteen, rambutan, and castilloa rubber.

7. A small para rubber plantation.

8. A small nursery plantation of more than 60 varieties of abaca.

9. A larger commercial plantation of abaca located on Mount Makiling and measuring about three hectares.

10. About three hectares of banana plantation containing more than 200 varieties.

LABOR REQUIRED

There is no phase of the work, in both development and maintenance, in which the students are not led to take an active part. As has already been stated, the students work in the capacity of student laborers; in performing field operations as a part of their regular studies; and in working out their graduating theses. A reasonable number of day laborers are now employed to help in carrying on the general work of the Farm. During vacations, especially summer vacations, self-supporting students and others, mingle with the common laborers, and work as such for daily wages.

Many of the annual or seasonal plantings on a small or larger scale are exclusively operated by students from the preparation of the ground to the harvesting and handling the crop product. In elaborate and intensive work, such as requires intelligent labor to handle special tools and delicate crops, the students have proven their efficiency. Where common labor is used because of interference with the students class room and laboratory work, or because of shortage of student labor, the students, as a part of their regular school work, are made to help now and then to carry out the more delicate operations. In planting trees, as well as short-season crops where distinct varieties are involved and certain special requirements need to be fulfilled, students are more likely than common laborers to follow directions in performing the work, and to do it right.

No single year has passed to the knowledge of the writer without the Farm work and its upkeep suffering from lack of labor. This usually happens during Christmas and summer vacations when most of the students are away from the College Campus. This shows that under the present circumstances, the College Farm work and its up-keep cannot be properly done without the aid of both the students and hired labor working side by side.

PRACTICAL WORK PRESCRIBED

A year's work in farm practice, carpentry, blacksmithing, and farm accounting is prescribed and required of all the students in the first year of their course, be the student an intermediate school graduate or a high school graduate. In so far as the farm practice is concerned the requirement is as follows:

1. Repeated hoeing and raking and use of other hand tools.
2. Preparing beds with the use of spades, hoes, and rakes for planting various garden crops.
3. Weeding and cleaning fields, orchards, lawns, drives, roads, paths, and borders.
4. Clearing forest land which includes underbrushing, digging stumps and trees, lopping, and burning trash with the use of heavy tools.
5. Heavy and light plowing, harrowing and cultivation, including newly cleared land, sod land, neglected fields, and cultivated fields in both upland and lowland situations, with single animals and teams of two or three animals hitched abreast.
6. Making and planting rice paddies.
7. Running complete cultures of standard crops as rice, corn, and sugar cane.
8. Harvesting grain and tuber crops as well as various other crops.
9. Helping advanced students in the field work of their graduating theses.
10. Simple practice in nursery, plant propagation, and orchard plantings.
11. Performing miscellaneous work as the general needs of the farm may demand.

A certain amount of field work is required in connection with the other agronomy courses offered by the College of Agriculture. In Agronomy I which teaches the basic principles of agronomy, field culture, and the handling of soils and crops, the students are required to run field cultures of rice, corn, legumes, and forages in all their cultural features. In Agronomy II, they are required to plant seeds and rear the seedlings of coconuts, abaca and other fiber plants, care for established plantations of long-period crops, and carry through cultures of annual fiber plants from planting up to the preparation of commercial fibers. In Agronomy III the students handle the nursery work for coffee, cacao, and tobacco; transplant seedlings and care for the established plantations of coffee and cacao; carry out the field study of sugar cane and cultures of tobacco varieties from the nursery work to the leaf curing. In Agronomy IV the students are given principles of plant culture and actual plant propagation, with special attention to gardening, truck farming and orcharding and the nursery work attached to them. In gardening each student is required to run a garden plot and plant various garden cultures with an eye to record keeping, proper preparation of the soil, water and fertilizer requirements of the crops,

and seed production. In orcharding, besides performing the exercises enumerated under the heading Plant Nurseries, the student is required to practice the technic of pruning for the proper formation of the tree, checking and stimulating growth and fruiting, and for the proper protection of the plants. In Agronomy V the students are taught genetics and methods of practice in plant breeding with field work in selection, head-to-the-row tests, and artificial hybridization. Lastly, in Farm Management they are given principles underlying the handling of farms as a business enterprise with due consideration to systems of farming, handling of farm labor, and the profitable disposal of farm products, all of which is supplemented with actual plantings for computation of cost of production and exercises in farm management survey.

BENEFITS FROM EMPLOYING COMMON LABORERS.

In the employment of common laborers on the College Farm, the workmen as well as the students are proportionately benefited. In the first place the benefit is reciprocal in that one learns from the other his desirable as well as his undesirable traits, coupled with the exchange of knowledge and experience in field operations. Good judgment on the part of one will lead him to learn and get the best the other possesses and make it a part of his working equipment. In the second place, the student comes in contact with and becomes familiar with this class of men, whom he is likely to handle when he gets out into real farm business; thus he learns while in College how to handle farm laborers. In the third place, the laborer, in his turn, gets the opportunity of increasing his knowledge, if he has had previous training, by handling, perhaps, new and better implements and employing new methods in farming operations. If he is not a regular farmer or farm laborer, he gets his training in addition to his wages, which may enable him to farm for himself. There have been in the Agronomy force men of both kinds, farmers and young unskilled laborers. The latter have learned all they know of the work on the College Farm, and the farmers have improved their methods considerably. Some of our thrifty men who know how to save, have left their job to start farming for themselves, a thing which should be stimulated and extended.

CONCLUSION

From the foregoing discussion, it can be readily seen that our students, in their farm work, aside from their superior training in the agricultural profession, are led to harden their muscles and develop such endurance and skill as is required for actual farm work. The policy is to make them efficient farmers; inculcating in them by object lessons the knowledge, "that a farmer to be successful must be a business man, a mechanic, a naturalist, and a skilled laborer, and that experience is necessary for success," to quote Prof. G. F. Warren of Cornell University.

PLATE I. AGRONOMY PRACTICUM.

PLATE II. POTTING COFFEE SEEDLINGS.

PLATE III. HORTICULTURE PRACTICUM.

PLATE IV. RICE CULTIVATION.

PLATE V. PLOWING.

PLATE VI. PRUNING MULBERRY TREES.

INSTRUCTION IN PRACTICAL PLANT BREEDING

By Nemesio B. Mendiola
Of the Department of Agronomy

FIVE PLATES

The course in practical plant breeding in the College of Agriculture may be divided into three main parts, namely; (I) applied study of variation, (II) selection, (III) hybridization combined with selection.

I. APPLIED STUDY OF VARIATION

Our instruction in Plant Breeding deals primarily with plant improvement. Every day the necessity of growing the very best crop that can be grown is emphasized to the students in every possible way. It is to be admitted, however, that before a student can appreciate a better crop, or a better variety, a better plant, a better seed, he must be given an object lesson, must be shown actually the objects of the instruction. To tell a student that he must grow better seeds is not sufficient. He must be shown these better seeds as well as the poorer ones, and taught how the better seeds are obtained.

Since the College of Agriculture was established, it has been accumulating an increasing number of seed and plant samples of all kinds of tropical crops. Many of these are now growing in permanent plantings while others are grown annually. We have for example some 800 so-called varieties of rice, 20 varieties of tobacco, 4 varieties of coconut, 30 varieties of abaca, some 350 varieties of banana, 19 of coffee and 20 of sugar cane. About the same condition obtains in regard to minor crops. The existence of so many varieties furnishes us with a very efficient and practical means of impressing on the minds of the students the fact that no two varieties are exactly alike in value or other characters; that in a group of varieties some are of better and some are of ordinary value, while still others are of little or no value at all. The students are taken to the field and are shown the differences that are to be found among the varieties. A typical example of this work may be found in the case of rice. It is known that one of the serious causes of the low average yield in the Philippines is the existence of hundreds of varieties whose yield is unprofitably low. There is then the problem of gradually eliminating them, a piece of work which must be shouldered mainly by the growers themselves. It is known, however, that our rice growers are very conservative and are not willing or are very slow to change the varieties which they have been growing for a number of years. This fact gives rise to a necessity of practical demonstration which must begin with students, with embryo farmers, among whom any desirable though radical change may readily find sympathy. This is actually done in Plant Breeding. There are in our rice breeding field about 80 varieties of rice which were planted by the students themselves. Students are taken to this field where they see with their own eyes how these different varieties look or behave. They find that some of them are short while others are tall; some have very few culms per plant, others have a greater nubmer; some varieties are early

maturing, others are very late; again, some are found to have small heads while others have heavier ones; some lodge a great deal, others hardly lodge at all. A student seeing such an exhibit of material can not fail to get clearly the fact that when he grows rice, there are varieties existing which he should grow and there are others which he should not plant.

Variation, however, occurs even within the best of unpurified varieties and the students are made to become acquainted with this fact, that no two individuals are exactly alike in yield or in appearance or in other characters, by actual plant tests, and subsequent studies of results in the field and in the laboratory, which they themselves make. Among other things, they make plant-to-row tests of rice, ear-to-row tests of corn, plant-to-row tests of sesamum and other minor crops. The object in these individual tests is to determine the performance of each plant, for this performance is the only correct criterion of the potential value of the plant as parent of a new generation. This point can not be too often emphasized. The farmers had, and many of them still have, a wrong conception of seed selection. It used to be thought that the yield value of a seed depends merely on its size. If this were true, by continuous fertilization and selection of larger seeds there is no limit to the improvement which may be obtained in the yield of any crop. The fact however is that "it is the blood that counts". A corn grain that is corn by heredity does not and can not produce a mango plant. Similarly, a large corn grain which is hereditarily a producer of small ears will continue to produce small ears despite whatever amount of fertilization makes this corn grain large. The behavior in heredity of a seed is its index value and this is shown by performance or individual tests.

II. SELECTION

Selection follows the study of variation. The individuals which previous tests have shown to be the cream of the group to which they belong are selected by the students and from the seed of these, students make new plantings. Obviously the class can not handle all the kinds of crops that we have. Their time is limited and besides, even some of the most important crops of the Islands are perennials. In spite of this, it may perhaps be claimed that nowhere is a student given as much practical selection work as is done in this College.

III. HYBRIDIZATION COMBINED WITH SELECTION

When all the variations which are at a breeder's disposal are no longer sufficient to allow a further new step in improvement, he must seek new variations. He must look for those lying dormant in seeds of such crops as are ordinarily propagated by cuttings. Sometimes this is the only hope or avenue for betterment. The students in this College are obliged to make plantings of seeds of such crops as sugar cane, cassava, abaca, potato, and others to teach them this important basis of plant improvement. More often, however, new types of individuals, new varieties or new strains must be produced by artificial crossing or hybridization. Different "blood streams" must be combined and recombined. Students in Plant Breeding make all sorts of crosses. There are several types of plants with regard to sex and because students in a fundamental way must know how to perform hybridization work with all of them, necessarily, this work can not be confined to only the most important crops of the country. Hence Plant Breeding students make crosses even with such plants as corn, papayas, cassavas, and eggplants. The new strains or varieties produced in this way are not necessarily valuable. They have to be tested and subjected to rigid selection and this kind of work our students also do.

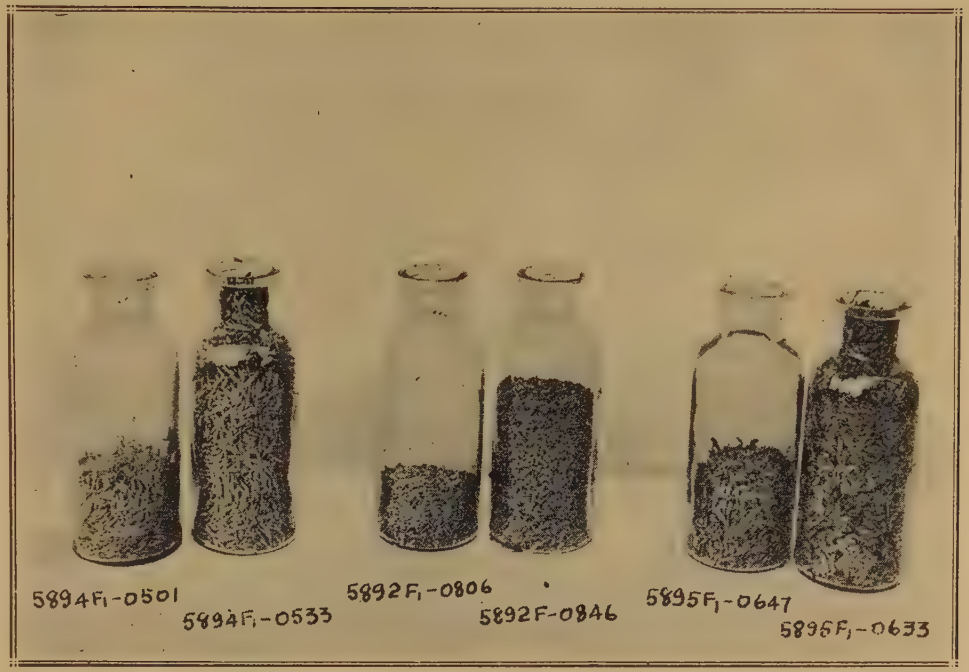


PLATE I. COMPARATIVE YIELDS OF 6 PLANTS, THE PROGENY OF SELECTED PARENTS OF 3 VARIETIES. BY SEED SELECTION, THE YIELD CAN BE EASILY DOUBLED.

PLATE II. UNIFORMITY, ONE OF THE CAUSES OF HIGH PRODUCTION.
PROGENY OF SELECTED PARENT PLANT 5894-0515 IROY.
AVERAGE YIELD PER PLANT—20.5 GRAMS.

PLATE III. NON-UNIFORMITY, ONE OF THE CAUSES OF LOW PRODUCTION.
PROGENY OF SELECTED PARENT PLANT 5894-0503 IROY.
AVERAGE YIELD PER PLANT—7.5 GRAMS.

PLATE IV. SELECTING CORN PLANTS AT EARLY STAGE.

PLATE V. SELECTING CORN PLANTS AT MATURITY.

WHY THE AVOCADO SHOULD BE WIDELY PLANTED IN THE PHILIPPINES

By E. J. Higgins
Of the Department of Agronomy

THREE PLATES

The avocado is a fruit of varying size and form ranging from a few ounces to two or three pounds in weight and from the spherical shape to long bottle-necked varieties with many intermediate shapes (Plates II and III). It grows upon a tree ranging from twenty to fifty feet in height and with an equally wide range in the spread of its branches, some varieties shooting straight upward with a single central stem and many side branches, and thus occupying little space while others are divided near the ground into a few large branches spreading out in all directions and in the full grown tree occupying a large amount of ground. The fruit has been known by many names, such as Alligator Pear, Palta Pear, Midshipman's Butter and in Spanish American countries as Aguacate, but the name Avocado is superseding all others in English speaking countries. To science the species is known as *Persea americana*, Mill. (*Persea gratissima*, Gaertn.)

The tree is indigenous in Tropical America and the West Indies and has only very recently been widely distributed beyond the borders of the Western hemisphere. This species has been introduced into the Philippines on numerous occasions during the last twenty years, and there are many very potent reasons why it should be widely planted in this Archipelago. A few of these will be enumerated.

First, because it is most pleasing to the taste. In countries where it is known, it is almost universally relished and is most highly prized by peasants and connoisseurs. The taste for avocados is an acquired one, but there is probably no fruit or vegetable for which a taste is so quickly acquired by those who at first do not care for it. The novice will probably pronounce the first fruit intolerable and will not succeed in eating more than a very small portion. The second fruit will be pronounced unattractive, the third tolerable, the fourth fair, the fifth good, the sixth delicious and after that the problem becomes one not of acquiring the taste but of getting the fruit frequently enough to satisfy the taste. Unlike the acquired appetite for drugs however, the taste for avocados results in no evil effects. There is absolutely no narcotic of any kind in the fruit and its effects are only beneficial.

There are numerous ways in which the fruit is used. It has been considered by some as primarily a salad fruit and perhaps it is more widely used in this way than in any other. For this purpose, the flesh is cut up in small cubes and is served with salad dressing of different kinds either alone or in mixed salads. Often the fruit is served without any preparation. It is prepared with oil, salt, pepper, vinegar or other condiments by the individual to satisfy his or her own taste. One of the most satisfactory means of employing the fruits is as a side dish to be eaten with the meat and vegetable courses. For this purpose, it is treated with salt and pepper to suit the taste of the individual and serves as a fatty element, frequently

replacing butter. It is also served as a side dish to be eaten with soup, while some prefer to leave it until the end of the meal, treat it with sugar and use it as a desert. Most excellent and nourishing sandwiches are made by placing pieces of the fruit properly seasoned between slices of bread. These are only a few of the almost innumerable ways in which this most valuable fruit can be used.

Second, because it is perhaps the most nutritious of all known fruits, it merits a large place in Philippine agriculture. Some varieties analyze as high as 20 per cent fat and few run lower than 10 per cent. Fortunately this fat is easily digested and the extracted oil has been used for convalescents. For this reason, the avocado forms a most important element in the fat supply in those countries where it is indigenous or where it has been very extensively planted. In many parts of the West Indies and Central America, the fruit is so cheap as to be well within the means of the poorer classes and in the country districts every one who has room for it on his property grows one or more avocado trees. Because of its richness in vegetable oil, as indicated above, it supplies during its season this very important and usually costly element in human nutrition. It is only necessary to consider the present prices of butter and its substitutes made of vegetable oils and the prices of lard to realize how much this supply of the most wholesome digestible fat must mean to the poor in those parts of the tropics where it is abundant.

A third reason, for urging the wide dissemination of this tree, lies in the fact that it is a good market fruit and can be made the basis of important production for domestic markets and for export. The possibilities of production of the avocado for market purposes in the Philippines can hardly be overstimated. The tens of millions of peoples not only in this Archipelago, but in the countries lying to the north, west, and south of us would consume vast quantities of the fruit. The possibilities of the avocado as an export fruit are only beginning to be realized in the countries where it has long been grown and its cultivation for this purpose is extending more rapidly in Florida and California, where it has been recently introduced, than in its native home. So keen is the demand for avocados in the great cities of the United States that prices ranging from 50 cents to $1.00 for a single fruit are not uncommon. In fact it is difficult to find a good fruit in the markets of New York or Boston for less than 50 cents gold. This suggests the keenness of the desire with which they are sought and has led to the establishment of large commercial orchards in very recent years in Florida and California. No fruit industry in California or Florida has sprung into importance more rapidly than avocado culture.

It has been found possible to ship the fruit long distances by proper methods of packing and handling. It was the writer's privilege to conduct some experiments along these lines in the shipping of avocados from Hawaii to the Mainland of the United States and it was found possible to land the fruit in Chicago in excellent condition for use, by means of refrigeration. This required about 17 or 18 days at least, and the fruit travelled over four thousand miles. Think for a moment of the vast markets that could be developed within half this distance from the Philippine Islands among the rapidly growing and unfolding nations of the Orient.

A fourth and very potent reason for its further distribution lies in its wide adaptability through its different types and varieties. This fruit may be found from the intense heat of sea level in the tropics to the regions of frost and snow

in the high mountains of Guatemala and Mexico. There are three well recognized types of the avocado known as the West Indian, the Mexican, and the Guatemalan. The West Indian type is pre-eminently that of lowland tropics. It endures a large amount of heat and prospers under it but is sensitive to cold weather. Its fruits are large and delicious and are borne in profusion. The varieties vary in color from pale yellow green through dark green to brown, purple, and wine color. The Mexican type is a small fruit of very thin skin and the foliage of this tree possesses usually the odor of anise. This type which appears to belong in the highlands of Mexico is much more resistant to cold weather than the West Indian type and some of its varieties will endure slight frost. The Guatemalan type is pre-eminently that of the highlands although it appears to prosper well even at sea level in some parts of the tropics. But it is this type which has made it possible to extend avocado culture into the sub-tropics and to such altitudes as carry it to the cool, and at times even cold climates within the tropical zone. The U. S. Department of Agriculture recently sent an explorer to Guatemala in search of the choicest varieties of this type and many of them were found between 6,000 to 8,000 feet above the sea in regions where frost and snow are not uncommon in the winter time. The fruits of the Guatemalan type which vary in size from medium to very large are characterized frequently by a very hard skin or shell-like covering, so firm that when the flesh is removed the shell may be set aside and kept for years without change of form. This thick rind is of course a great protection to the fruit in shipping, preventing many bruises which would destroy less protected, thin-skinned fruits.

A further advantage in these three types of the avocado lies in the fact that they vary considerably in their season of maturing fruits. The Guatemalan type tends to mature during the months from November to March in the Northern Hemisphere while the West Indian varieties are found ripening chiefly from April to September. There is, however, a sufficient variation in the time of ripening so that by proper selection it has been found possible to have mature fruits practically every month in the year.

But we are not speaking of a new and untried fruit which it is proposed to introduce into the Philippines. The American tropical agriculturists who first came to these Islands after American Occupation foresaw the great possibilities of the avocado in the Philippines and proceeded to make introductions. It was the writer's privilege to respond to some of these requests and to send from Hawaii seeds of several varieties of these fruits and recently to find a flourishing tree at Lipa, Batangas, planted about 1904 and probably the result of one of these early introductions. More recently, the U. S. Department of Agriculture has sent here trees of choice budded varieties and small orchards of the trees may now be seen at the Lamao Horticulture Experiment Station, in Bataan, at the College of Agriculture, at Los Baños and possibly elsewhere. These trees have fruited and have given every indication of being well adapted to the places where they have been tried.

It is not to be expected that the tree will prosper everywhere in these Islands but there is no question that a very wide range for successful culture will be possible. As has been indicated, so far as temperatures are concerned, varieties can be found adapted to practically all parts of the Islands where cultivated crops are grown. In the matter of moisture and drainage, however, the tree is more exact-

ing. Drainage is fundamental and no avocado tree should be planted on lands that can not be well drained. A wet, soggy, poorly aerated soil can not support successfully an avocado tree, but with good drainage a very wide range of rainfall can be endured without injury. The trees in the College orchards appear to have prospered during the past dry season without irrigation and those that have attained bearing age have produced excellent crops of fruit. Plate I shows an avocado tree in the College orchards, maturing a crop of fruit at the close of the dry season. Yet the avocado is not regarded as a drought resistant tree and ought not to be extensively planted in excessively dry places. Very heavy rainfalls do not appear to be injurious provided that the drainage is good and that the rains are not too continuous during the flowering season.

Another feature of the avocado which makes it widely adaptable and useful, is to be found in the fact that it will grow and develop excellent crops of fruit in gulches and on steep hill sides where many tilled crops could not be grown. It is not advocated that such lands be chosen for commercial orchards since the crop will well repay for the use of more valuable land and commercial orcharding can be carried on more successfully on lands lying level or with a gentle slope where tillage, spraying, and other orchard operations can be carried on economically and where the fruit can be gathered and transported on wagons or trucks. Nevertheless, these gulch lands may often be made profitable in growing avocado trees.

Other reasons might be added to establish the importance of the wide dissemination of the avocado in the Philippines, but sufficient has been said to show that every effort should be made by agricultural organizations and by individuals to establish the tree in every part of the Archipelago where conditions are suitable. No one should be guilty of permitting a single seed to be wasted at this time. A search should be made for the trees, that, doubtless, are rather widely scattered as a result of the early introductions and distributions. It is probable that hundreds if not thousands of these seeds are now going to waste every year because their value is not known by those on whose property they grow. As has been indicated above, the taste for the avocado is an acquired one, and most people who may not be well informed of its excellence and wholesomeness would try it, find it disagreeable and either destroy the tree or allow its fruits and seeds to go completely to waste. Because of the need of a larger number of seeds, the College of Agriculture has recently introduced from Hawaii a shipment of over 1700 seeds for new plantings. These will not be distributed as seedlings, since it is a well known fact that seedling trees are of uncertain quality and productiveness, while budded trees eliminate this element of uncertainty. Budded trees ought to be on sale in the commercial nurseries as soon as sufficient stock can be established and, as a matter of course, the Government agricultural agencies will distribute budded trees as rapidly as stock can be secured. Those who have seedling trees, however, ought to husband them carefully for seedlings often produce extremely valuable new varieties. In case any tree, after coming into bearng, fails to produce good fruit in abundance, it can easily be cut back and budded over to any one of a large number of choice varieties.

There can be little doubt but that the future will witness the development of avocado production with increasing momentum and the day will come when this fruit will form an important part of the dietary of the poor people as well as rich throughout the Islands and will be the basis of a great industry.

PLATE I. AN AVOCADO TREE IN THE COLLEGE ORCHARD AT THE CLOSE OF THE DRY SEASON.

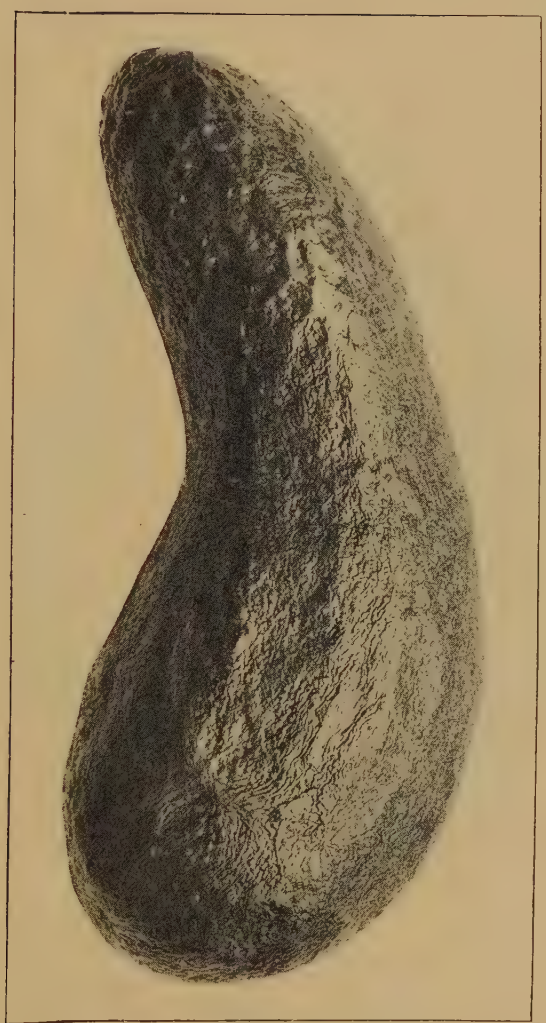


PLATE II. BOTTLE-NECK FORM OF AVOCADO.

PLATE III. PEAR SHAPED AVOCADO.

APPLICATIONS OF PLANT PATHOLOGY

By Otto A. Reinking

Of the Department of Plant Pathology

FOUR PLATES

Perhaps no arm of science fundamental to agriculture has applications of greater intrinsic value than those of plant pathology. These applications fall roughly into three classes. First, may be mentioned plant disease ordinances which have for their purpose the exclusion of the parasites from uninfected states or nations. Second, ordinances designed to limit the spread of diseases within a community. And third, the extermination or reduction of the parasite by specific control measures practiced by the farmer or by government agents.

It has long been recognized in the fight against fungus and insect pests that the law must be invoked. The Philippines, as well as the majority of countries, have adopted some form of legislation whereby plants may be excluded, inspected or quarantined for the control of plant diseases. These regulations are in the form of import and internal legislation. The first, includes general importation orders; and the second, orders of sanitary measures and those prohibiting shipments from infected districts within the country.

The import legislation includes various ordinances. The port of entry is of first importance. Certain places, or ports of entry, have been designated for the importation of plants and entry is prohibited at all other ports. Properly qualified inspectors are provided for the inspection of all plants on arrival. The Director of Agriculture has the power to prohibit the entry of any plant, or part of a plant, seeds, fruits, or any description of soil, or earth, or article packed therein, or class of goods, packages, merchandise, or coverings, or other articles which may be suspected of carrying fungi from any country. A careful inspection of hand bags and trunks is made to prevent bringing in plants with personal effects. Inspectors have the authority to destroy or quarantine all infected plants. A proper registry is kept of all importers, in which are recorded all items of plants or parts of plants which they bring into the country. Ordinances to provide for expenses, for the payment of fees, inspection, and quarantine; and to provide for penalties, rules, and regulations for the guidance of importers and inspectors are of great importance. In the case of internal legislation, the Director of Agriculture has the power to deal with all pests after introduction, and to provide machinery for their control and eradication.

In the Philippines, internal legislation has been used for some time to control various pests. Notable among these laws are the coconut bud rot acts which make it possible to control this serious disease by compelling owners to cut and burn all affected trees. The Bureau of Agriculture is empowered to carry on the eradication work and already has inspected millions of trees and burned thousands of infected ones. The extinction of abaca heart rot is also being carried out in the same manner. Laws have been passed prohibiting all shipments of abaca suckers from regions where the disease is prevalent. An inspection to determine whether it was feasible to exterminate the pink disease caused by *Corticium salmo-*

nicolor B. et Br. was made, but this fungus proved to be more prevalent and widespread than was at one time thought. As yet it has not been reported from the island of Basilan where extensive plantations of *Hevea* rubber are located. Precautions should be taken to prevent the entrance of the organism into that locality by the importation of infected plants.

The value of such regulations depends entirely upon the ability of the inpectors to detect destructive fungus and insect pests, consequently they must be trained in plant pathology and entomology. It is essential that all provisions of acts be enforced. It is not advisable to rely upon a certificate given by the shipper and countersigned by the department of agriculture of the country of origin. Consignments of this nature must be thoroughly inspected at the port of entry regardless of any previous treatment which they may have received. Usually the examination at the port is not alone sufficient to exclude all pests. A quarantine for the observation of all plants after importation should be established. Constant inspections of nurseries and botanic gardens should be made in order to detect any new diseases that may have appeared, and to destroy them before they spread.

Special inspection houses will have to be constructed in a way that will prevent the spread of insects and fungus spores into the surrounding country. A fumigation chamber for the disinfection of plants against insects and fungi as well as an incinerator for the immediate destruction of seriously diseased plants and the wrappings of such plants, will need to be provided. A quarantine or detention yard should be a part of the inspection station equipment. Plants which are apparently healthy can then be admitted and grown for a definite period under the watchful eye of a plant pathologist and an entomologist, before being certified free from pests. With such an organization a country is comparatively secure from the importation of serious plant pests.

The spread of coffee rust, caused by *Hemileia vastatrix* B. et Br. is a good example of how a destructive disease may pass from one country to another. In 1869 the disease was serious in Ceylon whence it quickly spread to southern India. In 1876 it reached Sumatra and three years later Java. From here it spread to the Philippines. This illustrates the necessity of absolute prohibition of the importation of certain plants, and the soil or any article packed with them, that may come directly or indirectly from any country having serious plant diseases.

Destructive corn diseases, which as yet have not made their appearance in the Islands, are present in countries near the Philippines. In Formosa a serious downy mildew of corn and sugar cane caused by *Sclerospora sacchari* Miyake, is doing extensive damage. Also the *Physoderma* diseases of maize produced by *Physoderma zea-maydis* Shaw and *Physoderma maydis* Miyake occur in southeastern Asia including India, Siam, Indo-China, and China; parts of the Malayan Archipelago, Fiji, Queensland, Australia, New Zealand, Oceania, Formosa, Japan, and adjacent islands. Since conditions in the Philippines are ideal for the growth of either of these diseases, it is essential, in order to prevent their introduction, to prohibit the importation in the raw or manufactured state, of seeds and all other portions of maize (*Zea mays* Linn.) and of closely related plants, including species of Teosinte (*Euchlaena*) Job's tears (*Coix*), *Polytoea, Dheonachue,* and *Sclerache* from any of the above listed countries.

A serious sugar cane trouble, called Fiji disease, which threatens to destroy the sugar cane industry of Fiji, is not present in the Philippines. The importation of sugar cane from these islands should be forbidden. Many diseases of bamboo, not in the Philippines, are prevalent in Japan. The Philippines are abundantly supplied with the best of structural bamboos, consequently importation is not necessary and should be prohibited.

Shipments of potatoes from the Hokkaido section in northern Japan are commonly covered with the sclerotial bodies and mycelium of *Rhizoctonia solani* Kühn. As this organism is already widespread in the Philippines, no regulations need be considered in this case. It serves, however, to illustrate the manner in which a disease may be introduced into a country.

Not only is it desirable to have thorough inspection and quarantine, but it is also advisable to send inspectors into the surrounding countries from which plants are imported, in order to obtain first hand knowledge of the character and destructiveness of diseases. Upon their return, such inspectors would render valuable services in the detection of all important pests that might be introduced by importation.

The College of Agriculture at Los Baños has an inspection staff whose duty it is to inspect all plants shipped into and out of the Experiment Station. Here are inspection rooms and quarantine gardens so that diseased plants can be properly handled. Students in the course in plant pathology learn the essential points to be considered in the proper enforcement of inspection and quarantine laws. They not only become acquainted with all the important plant diseases of the Islands, but must also know those infectious troubles that are not present, and are liable to be introduced. The College has trained plant inspectors and quarantine personnel for the Bureau of Agriculture.

Shipments of plants are constantly made to the College. These plants come from various parts of the world. Each year *Citrus* plants from China and other sections of the Orient are imported. They are first carefully inspected at the port of embarkation and then shipped in special wardian cases to the Philippines. Here they are inspected at the port of entry and then shipped to Los Baños where they are again inspected, (Plate I, fig. 1), before being planted in the quarantine nursery. The plants are then kept under observation for a period of six months before being distributed.

When a disease has once become established in a country it is advisable to use specific control measures. These may be the use of fungicides in spraying operations; plant sanitation in which the sources of infection are destroyed; crop rotation, whereby the causal factors are starved because of the absence of the proper host; culture methods, in which normal conditions for plant growth are provided; and the production of disease resistant varieties.

Students in the College are instructed as to the proper preparation of spray mixtures, (Plate I, fig. 2). The most efficient and practical sprays are made and applied. These included Bordeaux mixture, Burgundy mixture, lime sulphur mixture, and other types of copper and sulphur sprays. In the application of fungicides, various types of spraying apparatus are tested. Students carry on actual spraying programs in the vegetable gardens with bucket pumps

(Plate II). In the control of diseases of fruit trees a larger type of apparatus must be employed. Spraying operations are regularly carried on by the students in the citrus orchards (Plate III, figs. 1 and 2).

The practical side of plant pathology is always foremost in the minds of the instructors in charge of classes (Plate IV). While it is absolutely essential to understand the fungi that cause the diseases, the study of them is confined strictly to the essential factors in the life cycles. With a thorough understanding of the fungus, the students can apply the proper control.

Type of Faculty College.

Fig. 1. Inspection of Citrus plants.

Fig. 2. Preparation of Bordeaux mixture.

PLATE I.

PLATE II. GARDEN SPRAYING.

Fig. 1. Orchard spraying.

Fig. 2. Orchard spraying, showing barrel spray pump.

PLATE III.

PLATE IV. CLASS IN PLANT PATHOLOGY STUDYING COCONUT BUD ROT.

THE SUGAR CHEMISTRY COURSE AT THE COLLEGE OF AGRICULTURE

By Manuel L. Roxas

Of the Department of Agricultural Chemistry.

TWO PLATES

The purposes of the Sugar Chemistry Course at the College of Agriculture are primarily to teach the students how to make sugar from the sugar cane in the most economical way possible. Making sugar is practiced by expressing the juice of the cane and boiling it down to a point where sugar will separate out in the form of crystals. The process as described is very simple, and any body can easily make sugar in this way. But the problem of making sugar *economically* so as to obtain the greatest yield possible, is something which is more difficult. This is so because the extraction of the juice from the cane and the boiling of the juice are not as easily done as said. While a great part of the sugar may be extracted from the cane by simply pressing in a three-roller mill, yet a portion amounting to some fifteen per cent cannot be extracted even by repeated expressing in the same mill, and has to be removed by the combined use of water and heavy pressure. Again, cane sugar in solution when boiled, mainly in the presence of certain foreign substances such as are present in cane juice, easily undergoes decomposition. The problem of making cane sugar economically can be divided into two phases. The one has to do with the extraction of the sugar from the cane; the other with its separation from the juice, in which it is mixed with water and other foreign substances.

A student may be taught to make sugar economically from sugar cane in one of two ways. He may be placed in a sugar factory where he can be allowed to handle the different kinds of apparatus used in sugar making under constant expert supervision until he learns their use. Such a method will not require any previous knowledge of any principle or theory bearing on sugar making. The other way would be to have the student learn, before he is allowed to practice in a factory, the principles of sugar extraction from the cane, the behavior of sugar on boiling, and the different ways of purifying the juice and boiling it to obtain the sugar, in other words, the why and the wherefore of the different stages of sugar manufacture. The first method would be a purely practical one; the second, theoretico-practical. The student taught sugar making by the first method would probably be as proficient as the one taught by the second method in the use of the different kinds of apparatus for the making of sugar, under the conditions of the factory where they had been practiced, but if placed under other conditions the one who was given a purely practical teaching would be at a loss while the one who was also taught the why and wherefore of sugar making would know what to do.

The teaching of sugar making at the College of Agriculture is both theoretical and practical (Plate II). A part of the practical work consists in work in a small model mill which for the present, because of lack of funds, consists of small

laboratory equipment (Plate I). This practical work would undoubtedly be more efficient if the College had a commercial scale mill. After the work in the model mill the students are required to practice in a nearby central.

The following is an outline of some of the practical work done by the sugar chemistry students in the model mill.

1. Determination of the amount of sugar extracted by a three-roller mill from a given weight of sugar cane.—In this work the students weigh a certain amount of cane and grind it in a three-roller mill, and take the weight of the bagasse and juice. They then analyse in the laboratory samples of these products in order to determine the amount of sugar left in the bagasse and the amount extracted in the juice, and calculate from the analyses the per cent extraction.

2. Effect of maceration with water on the percentage extraction.—The students weigh a portion of cane, and after grinding it in the mill, sprinkle the bagasse with a weighed amount of water. They again pay the sprinkled bagasse through the mill, and analyze the expressed juice and the bagasse for sucrose, determining the percentage of extraction as before. A comparison of the first extraction with the second gives a practical demonstration of the effect of maceration. They again macerate with water the bagasse from the second grinding and pass it through the same mill and again calculate the per cent extraction. They then estimate the amount of water necessary to extract a given per cent of sugar from the cane.

3. Making 96° sugar from the juice.—The juices obtained in the above grinding are now combined. The acidity of the mixed juice is determined and after calculating the amount of lime required, the students weigh the latter which is then added to the juice. They then observe the movement of the precipitate, whether it settles quickly or slowly, and decide whether this particular juice should be limed to slightly alkaline or to slightly acid reaction. They also study the use of the lime meter for the proper liming of the juice. After liming the juice properly, it is heated to boiling in a vessel provided with a steam coil and then sent to settling tanks, where the mud is allowed to settle. The students determine the length of time necessary for the precipitate to settle completely. The clear juice is then sent to the evaporators where it is boiled to the desired density. The last stages of the boiling are done by the students in a small vacuum pan. With this pan they learn how to boil sugar to grain, how to increase the grain, how to increase the grain to a desirable size; and how to boil on seed. They also learn how to finish the graining with first molasses, determining the proportion of high purity juice and first molasses to use in each case. Then they learn when a charge (known as a "strike") is ready to be taken out of the vacuum pan to be sent to the mixer. After cooling, this charge, which is a mixture of sugar crystals and molasses, is centrifuged to separate these two constituents. The students determine by analysis whether the sugar needs washing and how much, to give 96.5° polarization. The final products are then weighed and the per cent yield calculated. This work is done by the students for several months so as to have them handle different varieties of cane and juices of different compositions.

In order that the students may realize whether or not they are making sugar economically, they determine the amount of sugar that enters the mill and the amount of sugar that goes out in the final product. The determination of the amount of sugar in the factory products can only be done by chemical analysis; students are therefore taught sugar analysis. Before the students can undertake this work intelligently they have to know in the first place what sugar is and its important properties. This involves some knowledge of organic chemistry and some knowledge of the language used in general chemistry. The students, to secure this, undergo a training in general and analytical chemistry, after taking mathematics, physics, and other subjects.

In following the course of sugar after it has entered the factory during its manufacture, in order to determine whether sugar is lost in the process, the students must be familiarized with the behavior of this substance upon heating under different conditions; that is, when the juice is underlimed or overlimed, and they of course have to be taught how to determine these points. It is known that the presence of certain foreign substances in the juice increases the amount of the sugar which is prevented from crystallization and retained in the molasses. A knowledge of these substances is therefore necessary for an intelligent control of sugar making. All of the above and many other things constitute the theoretical part of sugar chemistry. No more of this work is given than is necessary for a thorough understanding of the principles involved in the practical making of sugar.

Engineering laboratory (left); Administration building (back ground), College of Agriculture.

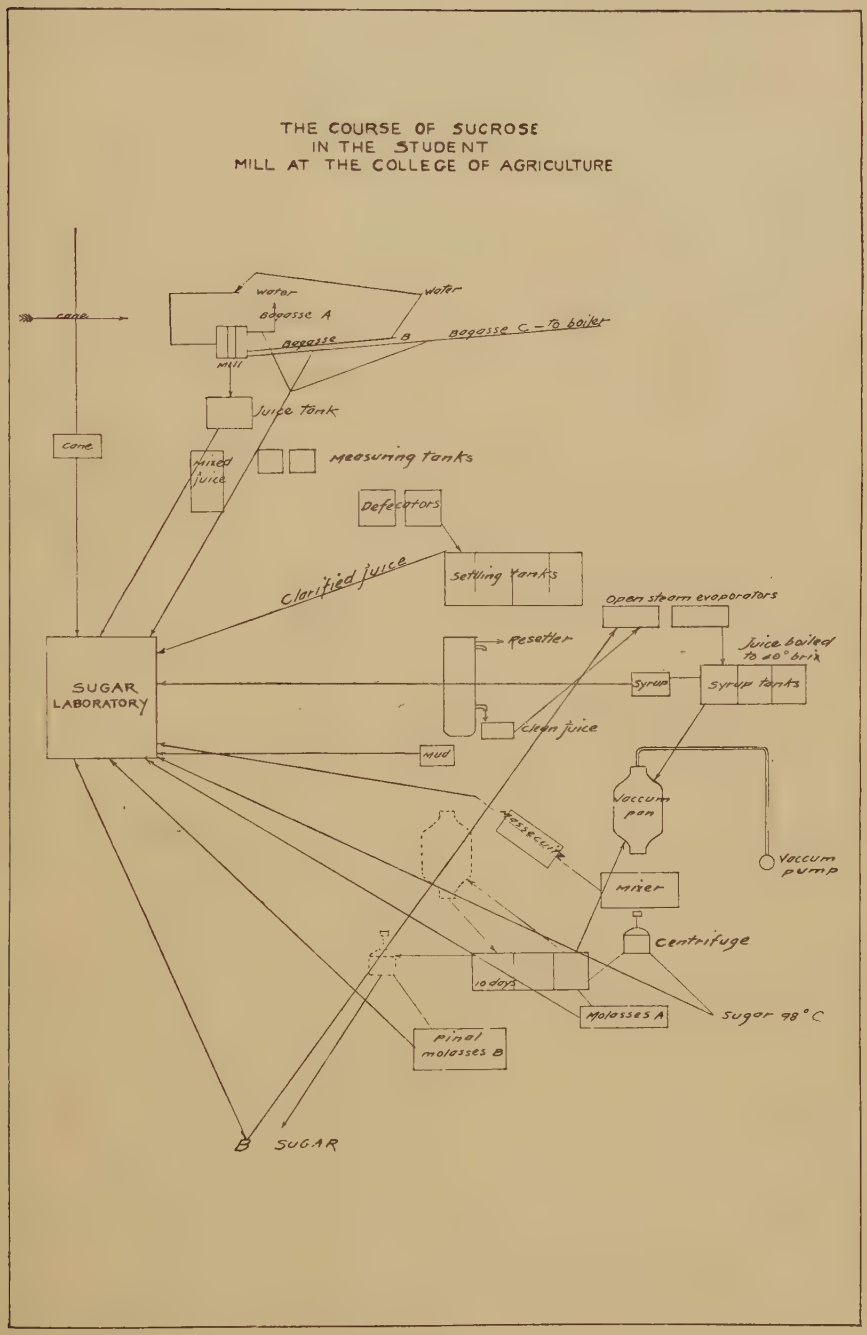

THE COURSE OF SUCROSE
IN THE STUDENT
MILL AT THE COLLEGE OF AGRICULTURE
cane
water
water
bagasse A
bagasse
B
bagasse C – To boiler
Mill
Juice tank
cane
Mixed juice
Measuring tanks
Defecators
Clarified juice
Settling tanks
Open steam evaporators
Resettler
Juice boiled to 40° brix
SUGAR LABORATORY
Syrup
Syrup tanks
Clean juice
MUD
Vaccum pan
Vaccum pump
Mixer
Centrifuge
10 days
Molasses A
Sugar 98° C
Final molasses B
B SUGAR

PLATE I.

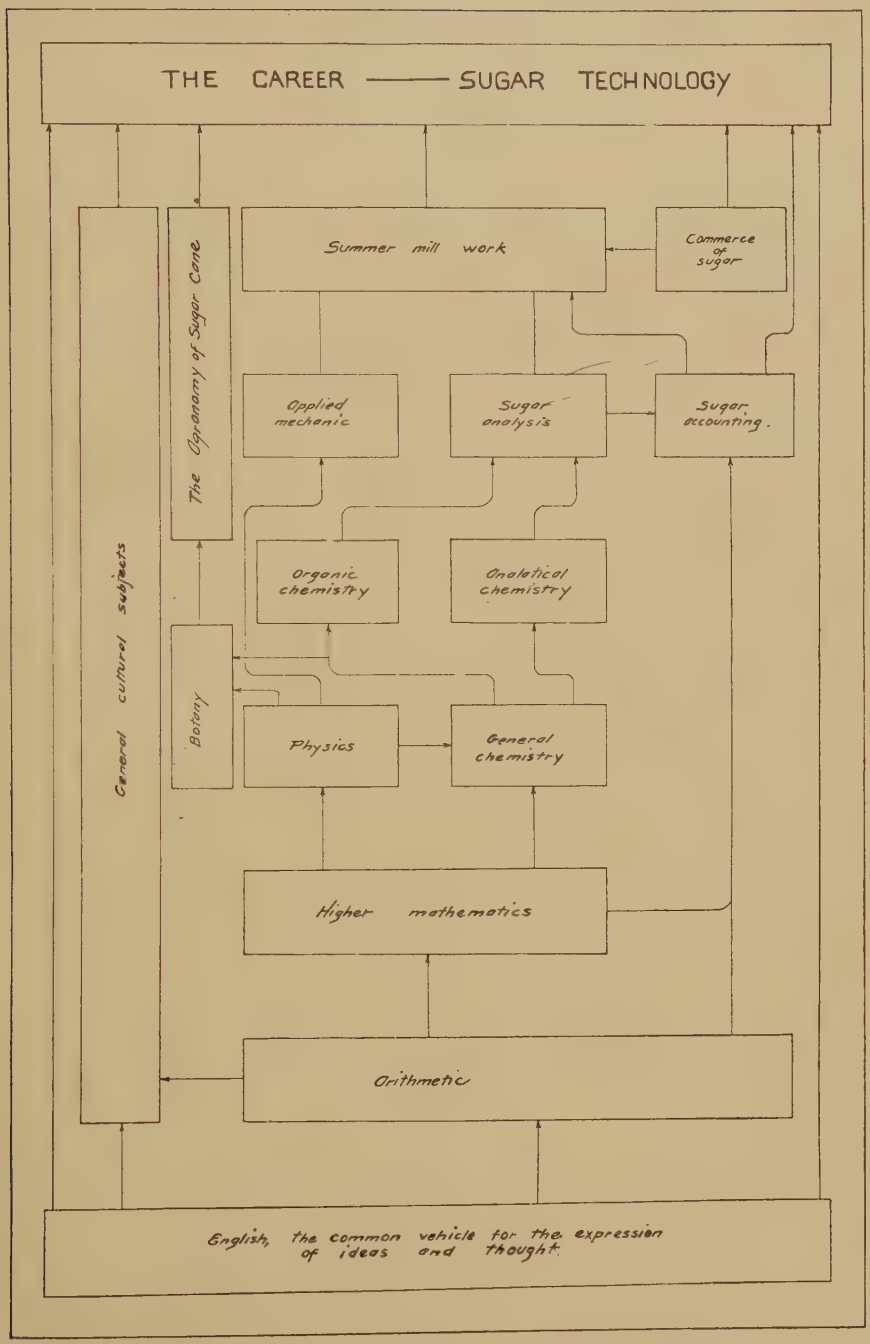


PLATE II. THE RELATION OF SUBJECTS IN THE SUGAR COURSE AT THE COLLEGE OF AGRICULTURE

THE COURSE IN FARM ACCOUNTING AT THE COLLEGE OF AGRICULTURE

By Evett D. Hester

Of the Department of Rural Economics

No side of farming has been more neglected than the business side. It is no easy task to turn the farmer into a scientist; it is as difficult a one to turn him into a business man. Since the days of Mediterranean civilization, artisans and tradesmen have practised bookkeeping and accounting. They have analyzed income and have allotted expenditure. Today, it is safe to say that not one farmer in a hundred keeps account of his projects, and not more than one in ten registers any accurate record of his cash income and outgo. Yet farming has, as a rule, a diversity of operation; a complexity of detail which demands careful bookkeeping just as much as, if not more than, some trade and commercial enterprises. There is by some expressed the opinion that the farmers as a class are lacking in business sense. Others advance the idea that his living comes so easily that he is careless of detail in its regard. Certainly the latter explanation is not true and the former is to be doubted.

More accurate explanations are to be found. Until comparatively recently, the small farmer did not deal in cash. He exchanged his crops for store credit, and his provisioner kept books for him. With fluctuation in values, this procedure became a losing proposition. It is now necessary for the farmer to hold and sell at proper times and frequently in new and distant markets.

It is only in recent years that fluid capital has been offered to the farmer, and he has been able to utilize borrowed money. Encumbered land and outside capital have made accounting a prime necessity.

Another reason appears in the fact that land has increased in value. The supply of soil resources has always been fixed. Population has forced neglected areas into cultivation. The limit of free land has been approached and the law of supply and demand has forced upward the value of every hectare. Now, as land increases in value, the owner must face the question, "Shall I rent or shall I farm?" If he decides to farm he faces the problem, "What projects will yield me more than the current rental rate?" At this point he is forced to deal quantitavely with every element, he must judge and compare, contrast and discard, limit or expand, certain undertakings. And there is but one final basis for this process—bookkeeping. Without it he may likely operate at a loss, and worse than that, may not know he is losing money.

Again, farming has in the past been surrounded with a sacrosanct atmosphere of the homestead. If the home was made, if the family was fed, clothed, sheltered, commonly educated, and the eldest son provided an inheritance of a few run-down acres, there was no question of success or failure. Social evolution has altered these ideas. Farming is rapidly coming to be a business, a sort of partnership-with-nature manufactory. It becomes an investment, insistently dependent upon the proper combining of diverse and numerous materials, all

valuable and their combination expected to yield greater value. The economic pressure falls heavily upon the modern agriculturist, and he must avail himself of every possible business technique.

FARM ACCOUNT SYSTEMS

Numerous systems have been provided for the keeping of farm accounts. Numbers of blank books, forms, and cost sheets have been edited and placed on the market. These vary from extreme simplicity to useless complexity with a scattering of genuinely helpful ones. Many bulletin writers have attempted to lay out a set of books on the theory that the farmer can not be expected to spend any considerable time in keeping them. Others have gone into all the conventions of commercial accountancy and have brought out sets so complicated that only a professional bookkeeper can handle them. Either product is useless. There can be no such thing as instantaneous or automatic accounting. No books will keep themselves, and none of any value will thrive on the farmer's odd moments or submit to the care of the younger members of his family. Time, a reasonable amount of time, can be expected if the farmer feels sure it pays. On the contrary, "blotters," card systems, cross postings, intermediate entries, and other elaborate refinements, intended for large scale commercial houses, are uselessly advised. Agricultural units are not, on the average, large scale, nor are they equipped with clerks and filing cabinets.

The efficient system for the farmer must be complete enough to afford valuable data and must contain no non-essential elements. Its requirement in materials should be simple, its demand in time, reasonable.

THE COURSE IN FARM ACCOUNTING AT THE COLLEGE

Realizing the importance of accounting as applied to the farm, the curriculum of the College of Agriculture carries a course in farm accounting for its students in their second year of training. The necessity of introducing the student to the purely business side of his intended profession early in his course is thus met. The course consists in general of two exercises each week throughout the year. These exercises are so grouped as to give a continuous and connected survey of a year of bookkeeping on a normal Philippine farm.

The course begins, where all accounting should begin, with the personal account. The form used is multicolumnar that is, it presents several columns for the classifying of income and a greater number of columns for the distribution of expenditure. The form is ruled on the pages of an ordinary forty-eight page school notebook, thus providing practice in lining sheets and requiring only a slight expense for material.

In his personal account, each student makes entry of all his income and outgo. At the end of the month the account is balanced, proved, and graded. The personal account continues through twelve consecutive months and credit for the course can not be had until this requirement is met. In the future, when sufficient correcting force can be employed, it is planned to require the personal account of all students in all years of their residence at the College.

The personal account once started and the collection and checking of the books systematized, the student passes to his farm bookkeeping proper. Each student selects a farm of between ten and fifty hectares of cultivated land. He makes a map of the farm, lays off his fields and buildings under the advice of the

instructor, and describes his crops and their rotation. He locates his farm in the region of his home, and his selection of crops is guided by this fact. The farm is given a name of local significance, often a dialect name. The implement, supply, and work animal requirements for each particular farm are figured and evaluated. The student is warned to avoid too heavy a capitalization and demonstrations of accounts are made to show how over-capitalization will affect his profits disastrously.

The farm selected, the student as proprietor takes his inventory, evaluates it, and designates the inclusive dates of his farming year, this, of course, being modified by local and climatic conditions. At this point each student has a different farm, a different capital stock, and is equipped to do his "paper" farming on a basis different from that of any other student. The course provides for the operation of the farm accounts month by month until the year is completed, the operations being made by the proprietor under the advice of the instructor.

A farm account book is opened by the student. The inventory is recorded. Accounts are opened with: cash; bank; proprietor (personal); capital; loss and gain; bills payable; bills receivable; household; each tenant; special labor; each class of the inventory, such as real estate, livestock, machinery, feed and supplies, etc.; and with all intended projects and crops, such as palay, maize, swine, poultry, garden and orchard, abaca, coconut, etc. The accounts taken together cover completely the operations of the farm. Each transaction made must be an exchange of value between two accounts. Double entry, that is, crediting the account from which the value originates and debiting the account to which the value is applied is required for each item of farm business.

The student is cautioned that his success is at stake and credit cannot be given for a losing farm. Moreover, all purchases and sales must be made at the price indicated in the Daily Market Reports of the Bureau of Commerce and Industry. No stuffing of yields, no under-payment of wages, nor non-interest borrowing is permitted. The proprietor must deposit the greater part of his cash in a bank and check against it. He is encouraged to borrow wisely when need arises and even to mortgage his property if it appears to be advantageous.

The form in which these accounts are kept consists of twenty-five double sheets of journal paper which are bound into a permanent book by the student. No ledger paper is required. No intermediate daybook is kept. The items are entered directly, but doubly, into the form. In this manner, the most cumbersome operation of bookkeeping, posting, is avoided. The essential element of all accurate accounting, double entry is, however, preserved. The form is technically known as a double direct-entry ledger.

At the closing of the farm month, a careful check is made by the correcting force. This work is voluminous because of the diversity of the accounts. Each set of books is different and must be scrutinized with care. A standard Dalton calculating machine is used by the correctors.

When the student has closed his twelfth month of farm operations he takes a closing inventory, calculates the depreciation and determines farm profits, family income, and proprietor's net gain for the year. Towards this point he has been working throughout the course and it constitutes in the course, as it would in actual practise, the climax of the year's work. The accountant now reviews the year's transactions in each project and discovers just where he lost

and where he gained, what was profitable, and what was unprofitable. The various undertakings of the farm are taken up and made to answer for their investment. The books are summarized, various data drawn out and compared, and the student pronounced either a success or a failure and credited accordingly.

The key of the entire course is that each student operates independently, a unique account of his own. The benefits of this diversity of the accounts are manifold. Club work on the part of a group of students, a thing that always happens when the old style problem is used, is precluded. To merely dictate a half hundred items to a class and ask them to strike a balance or form an inventory is arithmetic and not accounting. And it is the surest way to kill any interest in farm accounting. With each student a proprietor on his own responsibility, buying and selling at market prices the things he thinks he needs, with no dependence on his classmates, with the necessity of showing a profit at the end of the year under his own conditions, the course becomes a veritable game.

Seed laboratory and silk-culture house, College of Agriculture.

PRACTICAL WORK IN ANIMAL HUSBANDRY

By B. M. Gonzalez
Of the Department of Animal Husbandry

FIVE PLATES

Animal husbandry in the Philippines is yet in its infancy, and many of the problems encountered here, commonplace as they are in countries where the industry is developed, are new to our people.

The courses presented at the College of Agriculture at present do not aim to make specialists in animal husbandry but rather in agronomy, which forms the more important branch of our agriculture. Sufficient animal husbandry, however, is given to serve as a foundation for the development of this industry, which is bound to come in the very near future. It may be stated in passing that steps have just been taken to develop a course of specialization in animal husbandry which will rank in importance and thoroughness with our present agronomy course.

Animal Husbandry being eminently practical, it is next to impossible to get away from the practical side of it. The course which is given to all the student candidates for graduation, includes an elementary study of horses, carabaos, draft cattle, dairy cattle, beef cattle, range cattle management, swine, goats, and poultry. The work consists principally in becoming acquainted with actual types of animals in the Islands, and recognizing their good and bad points. This is absolutely essential in order to be able to choose efficient work stock, meat and dairy animals, and poultry. The students get acquainted with good types of animals that show their superiority not only in appearance, but in actual work in the field, dairy animals that prove their value in the amount of milk they produce, pigs that have made the biggest gains for certan periods and on certain feeds, and chickens that have shown their laying ability through records of egg production. This is the study of type as related to function.

About four hours of the seven hours of time a week devoted to the subject is taken up with such work. In addition, exercises are given on special work, as throwing down animals for examination and treatment of wounds, castration and caponizing, butchering, preservation of meat and eggs, proper methods of breeding animals, etc.

The rest of the time is devoted to the study of the principles back of successful methods of production and management. It is only through the understanding of such principles that improvement may be effected in the common practices. Also, the business side of the subject is taken up—the cost of feed, labor, investment, etc., balanced against the income from the sale of animals and animal products, and returns from work stock.

The writer has consulted a number of animal husbandry courses as given in American universities, and he has yet to find one that gives as much of what some choose to call strictly "practical work" as is given to our students here in the College of Agriculture.

PLATE I. HEREFORD CATTLE AT THE COLLEGE.

PLATE II. CAPONIZING.

PLATE III. JUDGING CARABAOS.

PLATE IV. JUDGING HORSES.

PLATE V. A CAPON WITH YOUNG CHICKS.

A COMPREHENSIVE PLAN OF INVESTIGATION IN SUGAR CANE AGRONOMY AND CHEMISTRY

By Manuel L. Roxas

Of the Department of Agricultural Chemistry

In making a review of the Government work on sugar cane in the Philippines, one finds that surprisingly little has been done towards the solution of the problem of producing the greatest amount of sugar per hectare with the minimum of labor, which should be the ultimate object of all technical investigations in this field. Much of the work published consists in the descriptions of the native methods of manufacture, and means for their improvement, or the reports of run tests of some new modern mill.

That nothing has been done regarding the economical production of sugar cane in the fields is due to the fact that there has never been organization of this line of work in the Islands. All studies made of our cane problems were scattered, and unconnected, with no attempt to carry them out systematically and continuously for a number of years. The result is that while at present we have isolated results of spacing and fertilizer experiments and variety tests made here and there, the present value of these, even for the localities where the work was done is almost nil, since they were done in single years and spasmodically and as a whole not along comparable lines.

The present drop in sugar prices, although not the result of a surplus of sugar, but due to a combination of New York refiners, is a timely warning that the fat years of sugar prices as the result of the European war will, in time, pass into history, and our sugar industry will soon be confronted by a high cost of labor and low sugar prices, a combination that spells disaster, unless we can solve in time the great problem of producing the maximum amount of sugar with the minimum of cost. Now is the time to launch a campaign for a comprehensive plan of investigation of our sugar industry. We must use all means to avert the disaster that threatens our sugar industry with the coming permanent drop in the price of sugar.

IMPORTANT PROBLEMS IN THE AGRONOMY AND CHEMISTRY OF SUGAR CANE AWAITING SOLUTION

The sugar cane, like most other economic plants, is very susceptible to changes of conditions. Moreover, the different varieties of cane respond differently to these changes, and different varieties demand different proportions of food elements from the soil. Thus, for instance, in Queensland[1] it was found that one variety took from the soil 163 pounds of K_2O, 83 pounds of P_2O_5 and 96 pounds of N, while another took 139 pounds of K_2O, 44 pounds of P_2O_5 and 107 pounds of N. Hence, to determine the best variety to raise and the most economic cultural methods in a given locality it will be necessary to study carefully, systematically and along absolutely comparable lines, the behavior of our present cane varieties, both native and foreign, in different soil and climatic conditions, taking also into account their susceptibility to prevailing local diseases. A consideration of these four important factors in crop production, viz: climate, soil, variety, and diseases and pests, will make the presentation of the problems clearer.

[1] The Queensland Agricultural Journal. Cited in Sugar Central and Planters News, Vol. I (1920), No. 14, page 254.

Climate.—Our Weather Bureau divides the climate of the Philippines into three general types which are designated as first, second, and third type. The first type is characterized by the absence of a dry season, and by a very heavy rainfall amounting to over 3,000 mm. a year. The second type has a well defined dry season lasting from December to April and a wet season from May till November. The rainfall during the dry season is about 170 mm. and during the wet season about 1,720 mm. The third type has also a well defined dry season, but this is much shorter than in the second type lasting only for two months, March and April, and with a rainfall of about 90 mm. during these months. The wet season lasts from May to February with a total rainfall of about 1,460 mm. Of these three types of climate, the second and third are favorable for sugar cane culture, but it is doubtful whether this plant could be profitably raised in places having the wet extreme of the first type of climate. When we compare the second and third types of climate we find that while the amount of rainfall in the second type is greater than in the third, the distribution in the latter is more uniform, which would perhaps be an advantage, mainly in the case of light soils.

Soil types.—The soil type is equally important in the study of sugar cane agronomy. Very little has been done in soil survey in the Islands and a comprehensive plan of investigation in sugar cane agronomy should be simultaneous with a complete survey and mapping of the sugar regions, since in starting this kind of work it will be of the highest importance to adopt a rational classification of our sugar cane soils. The soils may be classified according to their physical structure into sandy, light, medium, heavy, and very heavy. These types can again be sub-divided into rich, medium, and poor according to their chemical composition and the nature of the subsoil. It will also be of importance to consider the location of the field. For instance, a heavy soil in a low level site in places of heavy rainfall may be objectionable on account of its poor draining property, while the same type of soil may even have some advantages over the light ones on slopes where there is natural provision for drainage; or at a lower altitude in places where the amount of rainfall is scarce. In order to give a fair understanding of the relation between soil type and the growth of sugar cane, we quote here the results of five years of experiments in San José, Mindoro, from which it will be seen that the light soil under the climate of western Mindoro, which is of the second type, gave considerably greater yield than that obtained from the medium, and that the yields from the heavy and very heavy are very poor. It is to be noted that the cane fields of San José are at sea level, and have very slight slope.

TABLE I.—*Average yield in tons of sugar per acre according to character of soil for three seasons.*[1]

Type of Soil.	Plant.			Ratoon.		
	Acres.	Total yield of sugar.	Ave. per acre.	Acres.	Total yield of sugar.	Ave. per acre.
		Tons.	*Tons.*		*Tons.*	*Tons.*
Sandy	309.90	639.6113	2.06	468.5	455.3887	0.97
Light	1,831.67	4,704.8489	2.56	2,307.41	2,813.0234	1.21
Medium	3,939.23	7,220.9670	1.83	2,922.99	1,918.4640	0.96
Heavy	2,540.58	3,713.9187	1.46	1,929.44	1,918.4640	0.99
Very heavy	127.10	64.2375	0.51	421.11	162.2041	0.33
	8,748.48	16,343.5832	1.86	8,049.45	8,162.6035	1.01

[1] Sugar Central and Planters News. Vol. I (1920), No. 77, p. 7.

Variety.—There are now in the Islands over a dozen different native varieties of sugar cane under cultivation. Some of these are better adapted to certain sugar regions than to others and *vice versa*. We have a great number of other varieties both foreign and native including seedling varieties created here, the agronomical value of which for the different sugar regions has not been systematically investigated. As is well known, our soils are extremely diversified and while our climate has been divided into three types as indicated above, yet all sorts of gradation occur under each type. While it is possible to obtain in some places the right combination of climate and soil type for sugar cane growing, yet there are also many places where this combination is anything but satisfactory for the growing of our present varieties. A search for varieties that would make good growth under these unfavorable conditions should be started at once, as this would be the best way to bring success to sugar growing in these regions. Even in places where the climate and soil are most favorable for sugar cane culture, there is yet great room for the improvement of yield by proper cultural methods and for further betterment, by breeding and selection, of the varieties used.

Diseases of sugar cane.—The prevalent fungus and insect pests in each region should be known before any given variety can be recommended for that region.

A COMPREHENSIVE PLAN FOR EXPERIMENTS AND INVESTIGATIONS IN SUGAR CANE AGRONOMY

The purpose of these experiments should be:

1. To determine what places in the Islands are best adapted for sugar cane growing.
2. To determine how we can increase the yield of sugar on our old sugar land by:
    - *a.* Improvement in cultural method.
    - *b.* Improvement of the varieties used.
    - *c.* The use of fertilizers.
    - *d.* Irrigation and drainage where practicable.
    - *e.* Combination of any two or all of the above.
3. To search for hardy varieties of sugar cane better adapted than the present ones to those regions where sugar cane is grown in spite of the rather unfavorable climatic and soil conditions.
4. To develop in places where insect and fungus pests are serious, resistant varieties, which are best suited to the local conditions.

The investigations which should be made are:

1. Complete soil survey and mapping of our sugar regions.
2. A closer study of the rainfall and temperature of these regions.
3. A systematic study of the agronomical value of all the promising existing varieties of sugar cane, as well as of those newly created from seed by hybridization and selection. These experiments should be run for many years and in as many different types of soils and climatic conditions as practicable.
4. Further and more thorough study of our fungus and insect pests, the extent of damage done, and the best methods for their control.
5. Fertilizer studies. The question of the best fertilizer mixture to use in a given locality can only be answered after we have found out by field tests the response of the cane varieties to different

fertilizer mixtures under as many soil types as practicable, and carried out for long periods of time. The effect of the fertilizer mixtures on ratoon crops should be included in these studies.

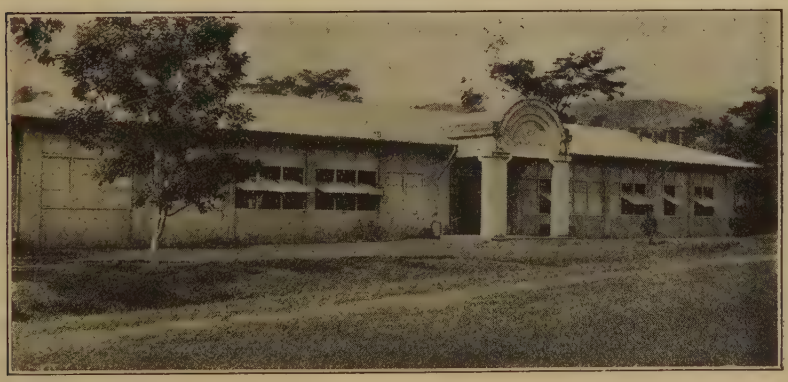
6. For a given type of soil there must be a distance of planting that will give just the right amount of space to the plants, without waste of land; such spacing as will produce the greatest yield of sugar per unit area. A systematic study of this question should be made in each region and for each soil type and variety.
7. Studies on the period of maturity of our cane varieties under different soil and climatic conditions. The importance of this problem is obvious, since canes should be cut for the mill when they have their maximum content of sugar, that is, when they are fully mature, and different varieties mature at different times even if planted in the same month, and the same variety may require different lengths of time when planted in different soil types and altitudes. The maturity would also vary with rainfall and temperature. It would be desirable to establish the relation between climatic factors and maturity for each locality with the view to determining whether the period of maturity of a given variety in a given place could be predicted from the rainfall and temperature curve. If this be possible it will be the simplest way of determining when to cut the canes for the mill.
8. Effect of irrigation and drainage on sugar cane, including a study of the cultural methods to practice in irrigated districts.
9. The growing of cane here for two seasons instead of one according to present practice. Would such a practice be economical as it is in Hawaii? While this will probably be impracticable in baguio-swept regions, since when cane is grown for longer than 12 months, it grows so high that it is liable to be blown down by the winds in the following typhoon months, yet this practice may be desirable in places like Cotabato, which is outside of the typhoon zone. The advantage in the longer growth of cane is in the fact that the plant will thus have a longer time to accumulate sugar, and in places where labor and not the land is the limiting factor it should prove very economical.
10. In the Philippines, as elsewhere, it has been observed that in newly opened land, sugar cane produces a rank growth but very poor and impure juice, and makers of muscovado sugar should not plant such fields with sugar cane before planting them to one or two crops of corn or rice since otherwise they would be unable to produce cane of sufficient purity to enable them to make even a fair grade of muscovado sugar from it. On this account new lands are the bugaboo of makers of muscovado sugar. It should be perfectly possible to turn this defect of virgin land into a great advantage with a judicious use of fertilizers. Our fertilizer work with sugar at this College, using a mixture containing 8 parts of K_2O, 6 parts of P_2O_5 and 8 parts of N, produced increase in the percentage of sucrose of the juice rather than rank growth in the plant, while

with an incomplete nitrogenous fertilizer the opposite obtained. It may be perfectly possible that a judicious use of potassic and phosphatic fertilizers would increase both the purity and sucrose content of the cane together with the heavy tonnage per hectare yielded by the virgin land.

11. A complete study of the composition and possible sources of fertilizers for our sugar lands should be undertaken together with the methods of conservation of soil fertility.
12. The introduction and adoption of the best farm implements and machinery to increase the efficiency of our farm laborers and to help decrease the cost of production per hectare.

Other related problems will suggest themselves in the course of the work along the lines indicated.

This kind of work will call for the most complete co-operation between the Government and the planters, since it will require so extensive a plan, that the Government with its present limitations would find it impossible to undertake it single handed. The work will have to be carried out by well organized experiment stations in co-operation with the planters.



Engineering laboratory, College of Agriculture.

GRADUATES OF THE COLLEGE OF AGRICULTURE

By Charles F. Baker
Dean, College of Agriculture.

Questions are often asked as to what College of Agriculture graduates are doing. Opinion is sometimes expressed that they are not a success. The following statement will quite fully and completely cover these points.

It is as clearly beyond reason to expect that every graduate of this College will be a *brilliant* success from the very beginning, as it is to expect such a record from every graduate of any other college in this or any other country. Nothing but years of experience can bring the maturity of judgment and efficiency that some men seem inclined to demand of our graduates from the beginning. Greater responsibilities have been thrown on the College of Agriculture graduates—due to the serious scarcity of trained men and urgent need of their services—than is ever done in the case of new graduates in America or Europe. Under this extraordinary test, we have been deeply gratified, as well as surprised, at their *average* very efficient and satisfactory performance, and words of appreciation of them are constantly coming in from the outside. As matters stand today, neither the College of Agriculture itself, nor the Bureau of Agriculture, would be able to operate, without the service of these graduates.

This says nothing of a thousand or more students who stayed in the College for varying lengths of time, but who left, in large part to engage in farming in all parts of these Islands.

GRADUATES OF THE COLLEGE OF AGRICULTURE

CLASS OF 1911

Bachelor of Science in Agriculture

Manuel L. Roxas.....Ph. D., University of Wisconsin. Professor of Agricultural Organic Chemistry, College of Agriculture, University of the Philippines, Los Baños.

Bachelors of Agriculture

Clodoaldo Tempongko.....Deceased.
Jose Zamora.....Farmer, Silang, Cavite.

CLASS OF 1912

Bachelor of Science in Agriculture

Vicente Allarey.....Farm Adviser, Bureau of Agriculture, Lucena, Tayabas.

Bachelors of Agriculture

Silvestre Asuncion.....Bureau of Agriculture Pensionado at the Audubon Sugar School, Louisiana, U. S. A.
Felipe Cevallos.....Bureau of Education Pensionado, University of Wisconsin, U. S. A.

ANDRES NAVARRO.....Captain Medical Corps, Philippine Constabulary, Baguio, Mountain Province.

TORIBIO VIBAR.....Instructor in Agronomy, College of Agriculture, University of the Philippines, Los Baños.

CLASS OF 1913

Master of Science

MANUEL L. ROXAS.....*Supra.*

Bachelors of Science in Agriculture

EDGAR M. LEDYARD.....Director, Agricultural Department, United States Smelting Co., Utah, U. S. A.

MARCELO CRISOSTOMO.....Farm Adviser, Bureau of Agriculture, Iloilo, Iloilo.

Bachelors of Agriculture

SOTERO F. ALBANO.....Fiber Inspector, Bureau of Agriculture, Manila.

FLORENCIO G. BAGUI.....Principal, Farm School, Bureau of Education, Batangas, Batangas.

VICENTE C. BARTOLOME.....Assistant Chief, Fiber Division, Bureau of Agriculture, Manila.

BIENVENIDO M. GONZALEZ.....M. S., University of Wisconsin. Professor of Animal Husbandry, College of Agriculture; Member, Board of Regents, University of the Philippines.

ANTONIO LEJANO.....Fiber Inspector, Bureau of Agriculture, Manila.

APOLONIO R. MUÑOZ.....Agricultural Inspector, Bureau of Agriculture, Sorsogon.

VALENTE E. VILLEGAS.....University of the Philippines Pensionado in Animal Husbandry at Iowa State College, U. S. A.

CLASS OF 1914

Bachelor of Science in Agriculture

NEMESIO B. MENDIOLA.....Ph. D. Cornell University, Assistant Professor of Agronomy, College of Agriculture, University of the Philippines, Los Baños.

Bachelors of Agriculture

ALFREDO P. ADRIANO.....Merchant, Koishikawa, Tokyo, Japan.

JOSE P. CAMUS.....Acting Chief, Agronomy Section, Bureau of Agriculture, Manila.

FRANCISCO GALANG.....Acting Chief, Horticultural Section, Bureau of Agriculture, Manila.

AMANDO LAPARAN.....Farm Adviser, Bureau of Agriculture, Santa Cruz, Laguna.

GONZALO F. MERINO.....Head, Pest Control Section, Bureau of Agriculture, Manila.

FRANCISCO A. QUISUMBING.....Fellow in Chemistry, Columbia University, U. S. A.

ELADIO SABLAN.....Fiber Division, Bureau of Agriculture, Manila.

JOSE P. TIRONA.....Farmer and practicing physician, Cavite, Cavite.

EUTIQUIO Q. ZULAYBAR.....Fiber Inspector, Bureau of Agriculture, Manila.

CLASS OF 1915

Bachelors of Science in Agriculture

VICENTE C. ALDABA.....Instructor in Agronomy, College of Agriculture, University of the Philippines, Los Baños.

CATALINO G. AURELIO.....Principal, Agricultural School, Bureau of Education, Banga, Capiz.

JOSE Q. DACANAY.....Bureau of Agriculture Pensionado, University of Illinois, U. S. A.

JOSE J. MIRASOL.....University of the Philippines Fellow, University of Illinois, U. S. A.

LEOPOLDO B. UICHANCO.....University of the Philippines Fellow, Harvard University, U. S. A.

Bachelors of Science in Forestry

ANTONIO P. RACELIS.....Assistant Professor of Forest Engineering, School of Forestry, University of the Philippines, Los Baños.

ANICETO VILLAMIL.....Bureau of Forestry, Manila.

Bachelors of Agriculture

SEVERO M. CAPISTRANO.....Bureau of Agriculture, Singalong, Manila.

AGRIPINO CONSTANTINO.....Supervising Teacher, Bureau of Education. Morong District, Rizal.

RAFAEL B. ESPINO.....Ph. D. John Hopkins University. Assistant Professor of Plant Physiology, College of Agriculture, University of the Philippines, Los Baños.

TEODORICO G. GHOFULPO.....Sugar central work, Binalbagan, Occidental Negros.

SEGUNDO D. LABAYEN.....Sugar chemist, Alto Cedro, Oriente, Cuba.

FRANCISCO D. MARQUEZ.....Station Superintendent, Assistant Agronomist, Bureau of Agriculture, La Carlota, Occidental Negros.

JOSE C. MIRAFLORES.....Sugar chemist, Ossorio Central, Hacenderos Association, Manapla, Occidental Negros.

PEDRO L. MONTELLANO.....Bureau of Education Pensionado, University of Wisconsin, U. S. A.

GERARDO O. OCFEMIA.....University of the Philippines Fellow, University of Wisconsin, U. S. A.

FRANCISCO P. OCTUBRE.....Assistant in Agronomy, Bureau of Agriculture, Manila.

ELIAS H. PANGANIBAN.....Instructor in Chemistry, College of Agriculture, University of the Philippines, Los Baños.

RAMON O. SARMIENTO.....Deputy Governor and Farm Adviser, Butuan, Agusan, Mindanao.

BLAS C. VELEZ.....Farmer, Barile, Cebu.

ARSENIO S. VICENCIO.....Farm Adviser, Bureau of Agriculture, Mexico, Pampanga.

TOMAS I. VISTA.....Farmer, Rizal, Laguna.

CLASS OF 1916

Masters of Science

INOCENCIO ELAYDA.....Professor of Farm Management, College of Agriculture, University of the Philippines, Los Baños.

NEMESIO B. MENDIOLA.....*Supra.*

GUY CLINTON.....United States Public Health Service, Washington, D. C., U. S. A.

Bachelor of Science in Agriculture

DOMINGO B. PAGUIRIGAN.....Bureau of Internal Revenue Pensionado in the United States.

Bachelors of Agriculture

FLORENTINO F. CRUZ.....Manager, Crescent Star Cattle Co., Bukidnon, Mindanao.

JOSE DE LEON.....In Charge, Citrus Station, Bureau of Agriculture, Batangas.

VICENTE M. DAWIS.....Assistant Farm Superintendent, College of Agriculture, University of the Philippines, Los Baños.

LUCIO A. SAN MIGUEL.....Deceased.

ALFONSO B. CAGURANGAN.....Bureau of Agriculture, Manila.

MARCELINO CONSTANTINO.....Farm Adviser, Bureau of Agriculture, Tansa, Cavite.

CORNELIO R. BALANGUE.....Farm Adviser, Bureau of Agriculture, Tuguegarao, Cagayan.

PANTALEON U. BACOMO.....Bureau of Agriculture, Manila.

GAUDENCIO PALAFOX.....Dammao Tobacco Station, Isabela.

CLASS OF 1917

Master Farmer

JOSE ZAMORA.....*Supra.*

Bachelors of Science in Agriculture

FRANCISCO ABADILLA.....Farmer, Lucena, Tayabas.
MARIANO E. GUTIERREZ.....Deputy Governor and Farm Adviser, Cotabato, Department of Mindanao and Sulu.
MARIANO MEDALLA.....Bureau of Agriculture, Manila.
HILARION SILAYAN.....Employed on Dr. Copeland's Farm, Chico, California, U. S. A.
FELIX B. SARAO.....Student in the United States.
LEOPOLDO G. MENDOZA.....Farmer, Sagnay, Ambos Camarines.
GREGORIO M. FRANCISCO.....Farmer, Sta. Rosa, Nueva Ecija.

Bachelors of Agriculture

TEOFILO CALINGASAN.....Farm Adviser, Bukidnon, Department of Mindanao and Sulu.
LEOPOLDO CLEMENTE.....Student, University of Illinois, U. S. A.
LEON EDROZO.....Superintendent of rice colony, Bureau of Lands, Abulug, Cagayan.
SIMEON FLORES.....Farm Adviser, Dumaguete, Oriental Negros.
ARSENIO A. GOCO.....Plant Pest Inspector, Pest Control Section, Bureau of Agriculture, Manila.
GREGORIO GRAGEDA.....Bureau of Agriculture, Siasi, Jolo.
DIONISIO B. PASTORFIDE.....Bureau of Agriculture, Boac, Marinduque.
CENON PAULICAN.....In Charge, Provincial Nursery, Pikit, Cotabato, Department of Mindanao and Sulu.
SIMEON REYES.....Pest Control Inspector, Bureau of Agriculture, Manila.
DIONISIO TUAZON.....Agricultural Assistant, Fiber Division, Bureau of Agriculture, Manila.
PAUL VILLYAR.....Acting Superintendent, Bureau of Agriculture, Alabang Stock Farm, Alabang, Rizal.

CLASS OF 1918

Masters of Science

JOSEPH A. COCANNOUER.....Education Manager, Western Soil Bacteria Co., San Francisco, California, U. S. A.
FRANCISCO QUISUMBING.....*Supra.*
LEOPOLDO B. UICHANCO.....*Supra.*

Bachelors of Science in Agriculture

PANTALEON BAUTISTA.....Farmer, Orani, Bataan.
JOSÉ TRINIDAD.....Manager, Unson Coconut and Cattle Projects, Parang, Cotabato.

Bachelors of Agriculture

EMILIO A. AFRICA.....Plantation Manager, Maganoy, Cotabato.
VICENTE ARAGON.....Farm Adviser, Bureau of Agriculture, Tarlac.
BASILIO BAUTISTA.....Farm Adviser, Bureau of Agriculture, Pasig, Rizal.
ARSENIO BAYLA.....Bureau of Non-Christian Tribes.

SANTIAGO FESTIN.....Agricultural Assistant, Department of Mindanao and Sulu, Davao, Davao.

PEDRO LAYOSA.....Deceased.

VALENTIN MACASAET.....Agricultural Superintendent, Iwahig, Penal Colony, Palawan.

JOSE MARIANO.....Farmer, Bigaa, Bulacan.

FAUSTINO OTANES.....Bureau of Agriculture Pensionado in the United States.

ALFONSO DE LA PAZ.....Animal Husbandman, Bureau of Agriculture, Lipa, Batangas.

EDUARDO QUISUMBING.....University of the Philippines Pensionado in the University of Chicago, U. S. A.

LEON ROMERO.....Farm Adviser, Bureau of Agriculture, San Carlos, Pangasinan.

CLARO SAMONTE.....Farm Adviser, Bureau of Agriculture, Bayombong, Nueva Vizcaya.

FRANCISCO B. SANTOS.....Farm Adviser, Bureau of Agriculture, Ilocos Norte.

GREGORIO SANTOS.....Assistant in Horticulture, Bureau of Agriculture, Lamao, Bataan.

ANASTASIO TEODORO.....University of the Philippines Pensionado in Agricultural Engineering, Wisconsin University, U. S. A.

CLASS OF 1919

Master of Science

FRANCISCO C. SANTOS.....College of Agriculture Fellow in Physical Chemistry, Yale University, U. S. A.

Bachelors of Science in Agriculture

ANTONIO R. CHANCO.....Farm Adviser, Bureau of Agriculture, Malolos, Bulacan.

RAMON K. HABALUYAS.....Mindoro.

TRANQUILINO D. VENTURA.....Chemist, Oriental Products Co., Bacolod, Occidental Negros.

Bachelors of Agriculture

FELIPE T. ADRIANO.....Student in Chemistry, University of Wisconsin, U. S. A.

EXEQUIEL ALCASID.....Animal Husbandry Division, Bureau of Agriculture, Manila.

JUAN B. CABANOS.....Bureau of Agriculture, Manila.

ESTEBAN COLLADO.....Assistant in Chemistry, College of Agriculture University of the Philippines, Los Baños.

PEDRO A. DAVID.....Assistant in Agronomy, College of Agriculture, University of the Philippines, Los Baños.

LEONCIO DARIO.....Agricultural Assistant, Bureau of Agriculture, La Carlota Experiment Station, Occidental Negros.

JOSE ESGUERRA.....Farm Adviser, Bureau of Agriculture, Nueva Ecija.

FRANCISCO M. FRONDA.....College of Agriculture Pensionado in Poultry Husbandry, Cornell University, U. S. A.

JOAQUIN GONZALEZ.....Farmer, Apalit, Pampanga.

NEMESIO HERNANDEZ.....Tobacco Experiment Station, Dammao, Isabela.

TOMAS HARDER.....Farm Adviser, Bureau of Agriculture, Capiz.

VICENTE HIDALGO.....Animal Husbandry Division, Bureau of Agriculture, Alabang Stock Farm, Alabang, Rizal.

FRANCISCO LAGO.....Assistant in Animal Husbandry, College of Agriculture, University of the Philippines, Los Baños.

BENEDICTO C. LEANO.....Tobacco Inspector, Bureau of Internal Revenue, Manila.

ANASTACIO LIPAYON.....Student in the University of California, U.S.A.

GASPAR LINDAYAG.....Bureau of Agriculture, Manila.

MELECIO MANIO.....Farm Adviser, Dansalan, Lanao, Department of Mindanao and Sulu.

TIBURCIO NARABAL.....Farm Adviser, Bureau of Agriculture, Cagayan, Misamis.

TEOFILO NISCE.....Fiber Inspector, Bureau of Agriculture, Manila.

JOSE NOGUERRA.....In Charge, Animal Husbandry Breeding Station, Bureau of Agriculture, Batangas, Batangas.

FELIPE PADOLINA.....Assistant in Horticulture, Bureau of Agriculture, Lamao Experiment Station, Bataan.

FERNANDO DE PERALTA.....Assistant in Plant Physiology, College of Agriculture, University of the Philippines, Los Baños.

FRANCISCO R. RED.....Farm Adviser, Bureau of Agriculture, Lipa, Batangas.

EMILIANO ROLDAN.....Assistant in Plant Pathology, College of Agriculture, University of the Philippines, Los Baños.

RAYMUNDO SABADO.....Assistant in Agronomy, College of Agriculture, University of the Philippines, Los Baños.

FELICISIMO SERRANO.....Assistant Plant Pathologist, Bureau of Agriculture, detailed in the Bureau of Science, Manila.

VICTOR SULIT.....Assistant in Chemistry, College of Agriculture, University of the Philippines, Los Baños.

JUAN P. TORRES.....Bureau of Agriculture, Manila.

DEOGRACIAS B. VILLADOLID.....Assistant in Zoology, College of Agriculture, University of the Philippines, Los Baños.
GERMAN YAP.....Mindoro.
VALENTIN ERESE.....Deceased.

CLASS OF 1920

Masters of Science

VICENTE ALDABA.....*Supra.*
MARIANO MEDALLA.....*Supra.*
GERARDO OCFEMIA.....*Supra.*
TOMAS VISTA.....*Supra.*

Bachelors of Science in Agriculture

ANTONIO DERECHO.....Farm Adviser, Bureau of Agriculture, Manila.
ISIDORO GUZMAN.....Farmer, Cabagan, Isabela.
MARIANO JURADO.....Bureau of Agriculture, Manila.
POLICARPO PADLAN.....Bureau of Agriculture, Lipa, Batangas.
SIMEON PANGANIBAN.....Farmer, Lipa, Batangas.
PEDRO PAULINO.....Bureau of Agriculture, Manila.
GAUDENCIO REYES.....Bureau of Agriculture, Manila.

Bachelors of Agriculture

ANGEL AFRICA.....Assistant in Physics, College of Agriculture, University of the Philippines, Los Baños.
JOSE CAPINPIN.....Assistant in Agronomy, College of Agriculture, University of the Philippines, Los Baños.
MAXIMO P. CANONIZADO.....Department of Mindanao and Sulu.
NEMESIO A. CATALAN.....Assistant in Agronomy, College of Agriculture, University of the Philippines, Los Baños.
GREGORIO D. CAZENAS.....Farmer, Dao, Antique.
FELICIANO H. CLARA.....Bureau of Agriculture, Manila.
ISIDORO R. COLLADO.....Student in the United States.
JOSE P. CORRALES.....Farmer, Mambajao, Misamis.
ANIANO R. ELAYDA.....Farmer, Baliangao, Misamis.
HILARION H. ESTALILLA.....Farmer, Aringay, La Union.
SIMPLICIO F. FESTIN.....Farmer, Odiongan, Romblon.
ANDRES P. GOSECO.....Employed on Dr. Copeland's Farm, Chico, California, U. S. A.
JULIO M. JAMIAS.....Assistant in Chemistry, College of Agriculture, University of the Philippines, Los Baños.
ANSELMO F. LABRADOR.....Bureau of Agriculture, La Carlota Experiment Station, Occidental Negros.
ANASTACIO M. LIMBO.....Bureau of Agriculture, Agricultural Assistant, Bukidnon, Mindanao.
JUAN G. LIZASO.....Bureau of Agriculture, Animal Husbandry Division, Alabang, Rizal.
AMBROSIO M. LONTOK.....Farmer, Lobo, Batangas.
GREGORIO B. LONTOK.....In Charge of United States Department of Agriculture Project in Los Baños.

ALEJANDRO S. MANGONON.....Farmer, Manauag, Pangasinan.
SEVERO J. MARIANO.....Assistant in Agronomy, College of Agriculture, University of the Philippines, Los Baños.
EMILIO K. MORADA.....Farmer, Lipa, Batangas.
JULIAN A. MORADA.....Farmer, Lipa, Batangas.
SERAPIO M. PALAFOX.....Bureau of Agriculture La Carlota Experiment Station, La Carlota, Occidental Negros.
MELQUIADES S. PUGEDA.....Farmer, Rosario, Cavite.
PEDRO S. ROJALES.....Farmer, Indang, Cavite.
ROMAN G. TOMANENG.....Bureau of Agriculture, La Carlota Experiment Station, La Carlota, Occidental Negros.
CRISPIN B. VILLANUEVA.....Agricultural Assistant, Department of Mindanao and Sulu.
LEON B. VILLANUEVA.....Assistant in Agronomy, College of Agriculture, University of the Philippines, Los Baños.
MARIANO F. VILLARAZA.....Farmer, Majayjay, Laguna.

SUMMARY OF EMPLOYMENT OF GRADUATES
AS OF JULY, 1920

Farmers	26
Merchant	1
Sugar Chemists	3
Educational Service:	
Bureau of Education	4
College of Agriculture	25
Technical Government service:	
Mindanao-Sulu	8
Bureau of Lands	1
Bureau of Internal Revenue	1
Bureau of Prisons Penal Colonies	1
Bureau of Agriculture	64
United States Department of Agriculture	1
United States Public Health Service	1
Philippine Constabulary	1
Abroad for advanced training from various departments of the Government or privately	17

SUMMARY OF ADVANCED DEGREES CONFERRED ON GRADUATES

Degree Master of Science	9
Degree Doctor of Medicine	2
Degree Doctor of Philosophy	4

VARIOUS DATA REGARDING THE 1920-21 ENROLLMENT

TOTAL NUMBER OF STUDENTS	528
POST GRADUATES	21
FOUR YEAR GENERAL COURSE:	
1st Year	13
2nd Year	16
3rd Year	8
Seniors	5
FOUR YEAR ANIMAL HUSBANDRY COURSE:	
1st Year	5
2nd Year	3
3rd Year	2
Seniors	1
B. S. SUGAR TECHNOLOGY COURSE:	
1st Year	6

SIX YEAR GENERAL COURSE:

1st Year	173
2nd Year	91
3rd Year	37
4th Year	31
5th Year	46
Seniors	36

SIX YEAR ANIMAL HUSBANDRY COURSE:

1st Year	7
2nd Year	14
3rd Year	4
4th Year	0
5th Year	0
Seniors	0

SPECIAL STUDENTS: 3

AGES OF STUDENTS IN YEARS:

14	2
15	7
16	20
17	30
18	49
19	54
20	71
21	32
22	62
23	50
24	41
25	25
27	11
28	10
29	2
30	3
31	2
32	3

ATTAINMENTS OF NEW STUDENTS:

HIGH SCHOOL

1st Year	155
2nd Year	24
3rd Year	3
4th Year	...
H. S. Graduates	23

LOCAL ADDRESSES OF STUDENTS:

Campus	346
Coconut Grove	109
San Antonio	16
Batong Malake	3
Anos	7
Town	29
No definite residence	9

STUDENTS FROM DIFFERENT PROVINCES:

Abra	4
Albay	14
Bataan	1
Batanes	1
Batangas	58
Bohol	14
Bulacan	26
Cagayan	13
Camarines Norte	0
Camarines Sur	7
Capiz	11
Cavite	58
Cebu	3
Ilocos Norte	15
Ilocos Sur	8
Iloilo	18
Isabela	5
Laguna	44
La Union	9
Leyte	6
Manila	11
Marinduque	..
Mindanao and Sulu:	
Agusan	..
Bukidnon	..
Cotabato	3
Davao	1
Lanao	1
Sulu	2
Zamboanga	1
Mindoro	2
Misamis	5
Mt. Province	2
Nueva Ecija	24
Nueva Viscaya	2
Occidental Negros	11
Oriental Negros	1
Palawan	2
Pampanga	16
Pangasinan	69
Rizal	24
Romblon	2
Samar	2
Sorsogon	2
Surigao	..
Tarlac	11
Tayabas	10
Zambales	17
Foreigners	6

NUMBER OF NEW STUDENTS ACCORDING TO YEARS

1909	55
1910	40
1911	98
1912	111
1913	140
1914	162
1915	195
1916	201
1917	219
1918	44
1919	205
1920	298
TOTAL	1668

FACTS ABOUT THE COLLEGE OF AGRICULTURE, UNIVERSITY OF THE PHILIPPINES

Located near Los Baños, Laguna. Established in June 1909.

Enrollment by years:

1909	55
1910	95
1911	175
1912	253
1913	294
1914	380
1915	428
1916	450
1917	564
1918	366
1919	462
1920	527

Total number of alumni 165

Faculty members:

Professors	9
Associate Professors	3
Assistant Professors	5
Instructors	6
Assistants	19
Total	42

Present value of entire plant	₱371,805
Present annual support	402,880
Average present annual cost of operation per student, about	690
Number of students partly or entirely self supporting	182
Student living expense, per month,	20–30
Area of grounds, hectares	360
Number of permanent buildings	15
Number of work animals: horses, native bullocks, and carabaos	53
Number of Indian buffaloes for breeding	5
Number of Indian cattle for breeding	11
Number of swine	24
Number of goats	12
Number of poultry	267
Area devoted to animal husbandry farm, hectares	140
Average number of paid laborers employed in farm work	48
Area in culture, hectares	125

Number of plants in permanent plantings of cacao, coconuts, abaca, coffee, fruits, etc	25,000
Number of plants, plant cuttings and seed samples distributed through students and otherwise from 1909 to 1920	900,000
Number of cultures in constant progress, including seed selection, fertilizer tests, etc	3,500
Number of pages in publication of original studies and investigations by faculty	8,000
Number of pages in publication of original studies and investigations by students	1,872

Tuition, free.

Administration building, College of Agriculture.

VIEWS

OF THE

COLLEGE OF AGRICULTURE

AND ITS ACTIVITIES

PLATE I. FIELD WORK IN SURVEYING.

PLATE II. CLASS IN PLANT ANATOMY.

PLATE III. FIELD CLASS IN ENTOMOLOGY

PLATE IV. CAMPUS FROM THE NORTHWEST.

PLATE V. RED CROSS CAMPAIGN. 1918.

PLATE VI. STUDENTS ENLISTED IN THE NATIONAL GUARD. LEAVING FOR CAMP CLAUDIO. 1918.

PLATE VII. EXPERIMENT STATION FIELDS.

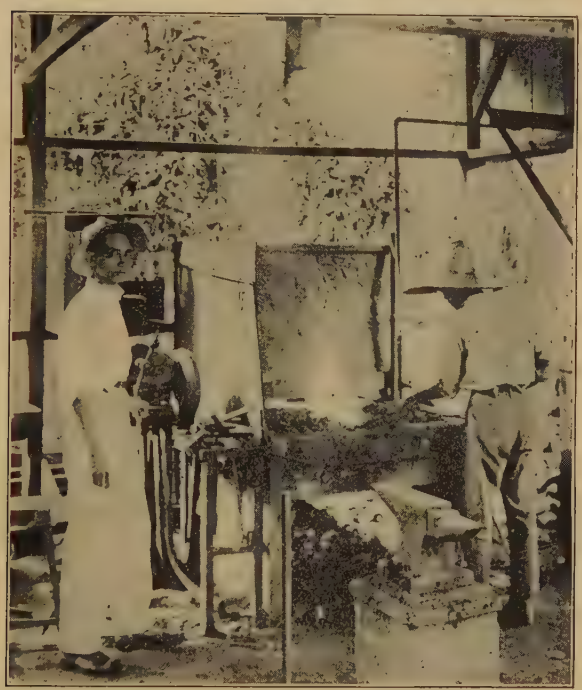
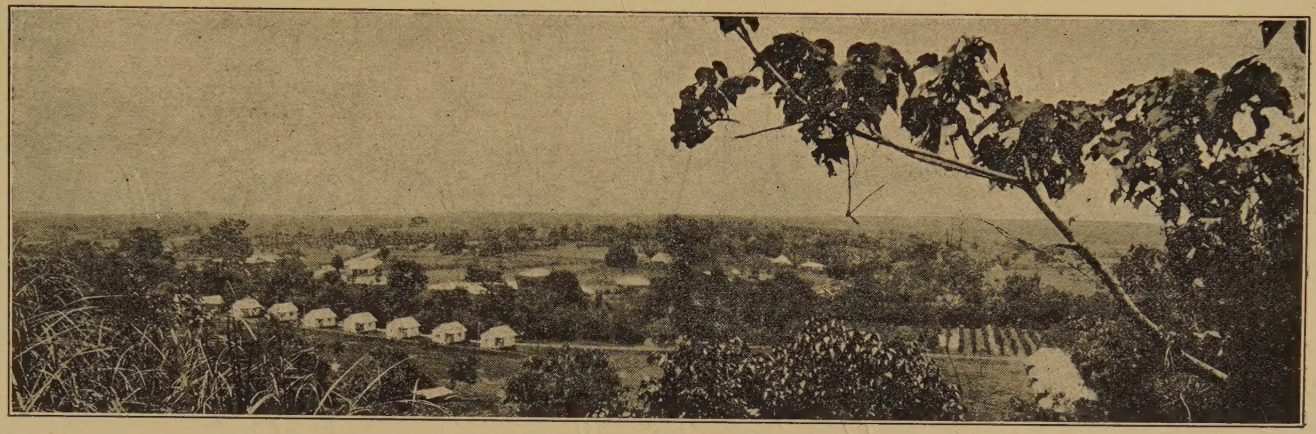


PLATE VIII. FORGE WORK.

PLATE IX. VISITING DELEGATION OF PROVINCIAL GOVERNORS.



Photograph by C. R. del Rosario

PLATE X. PANORAMA OF CAMPUS SHOWING STUDENT QUARTERS.